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ABSTRACTS

of recent published material on Soil and Water Conservation

Number 20

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"ABSTRACTS of recent published material on Soil and Water Conservation" are abstracted by Charles B. Crook in the Soil and Water Conservation Research Division of the Agricultural Research Service.

They are issued at irregular intervals, and their purpose is to bring together a summary of current published information about soil and water conservation for ready reference of those actively engaged in soil and water conservation work. Reprints of abstracted articles are generally not available in the Division. Requests for reprints should be sent to authors or institutions--addresses have been appended to abstract.

The classification of articles follows the table of contents used for the "Soil and Water Conservation Research Needs" presented by the Soil Conservation Service. Mr. Crook is abstracting completely enough so article need not be consulted unless details are required. In case of a review, or a "how-to-do-it" article then the abstract is not complete. Abstracted articles are not editorialized and the language of the author is used wherever possible. In foreign articles, the units of measure are converted to usual American units. Tables are included where they help to present the information. When an entire number of a publication is devoted to reviewing one subject then the entire publication is abstracted as one article giving title and authors of each paper included in the publication. Abbreviations of journals and addresses are the standard ones set up by the U. S. D. A. Library in U. S. D. A. Misc. Pub. 765, July, 1958.

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CONTENTS

Page

WATERSHED ENGINEERING

Watershed development ... 1
Hydrology ... 5
Geology ... 6
Engineering design ... 7
Snow surveys ... 9
Ground water recharge ... 10

WATER MANAGEMENT

Irrigation ... 12
Drainage ... 16
Evaluation of flood water damage ... 19
Storage and conveyance ... 20

BASIC SOIL PROBLEMS

Soil structure ... 24
Soil-Water relationships ... 25
Lime ... 28
Soil chemistry ... 30
Soil physics ... 36
Soil biology ... 37

EROSION CONTROL

Wind and Water Erosion ... 39
Strip cropping ... 41
Critical areas ... 42

SOIL MANAGEMENT

Cropping practices ... 45
Crop residue management ... 50
Tillage ... 52
Fertility requirements for conservation farming ... 58
Salinity and alkali problems ... 67

Page

SOIL MANAGEMENT--Continued

Cover crops ... 67
Climatic influence ... 69
Surface soil removal ... 74
Mulching ... 75

PLANT MANAGEMENT

Pasture and haylands ... 77
Rangelands ... 89
Plant materials ... 96
Woodlands ... 99
Fruit and nut crops ... 110
Field crops ... 112
Vegetable crops ... 118

ECONOMIC AND SOCIAL

Costs and returns ... 127
Institutional and educational ... 131

BIOLOGY

Fish ... 137
Upland wildlife ... 138
Wetland wildlife ... 143

SUPPLEMENT

Problems affecting application ... 148
Soil-plant relationships ... 149
Radioactive fallout ... 152

SOIL SURVEYS

Genesis and morphology ... 153
Classification and land use ... 161
Mapping and interpretation ... 162

WATERSHED ENGINEERING

Watershed Development

Gutermuth, C. R. Chairman. SEVENTH NATIONAL WATERSHED CONGRESS. 195 pp. 1960.

The Seventh National Watershed Congress was held in Washington, D. C. on April 18 to 20, 1960. The meeting consisted of:

1. Remarks by C. R. Gutermuth, Arthur E. Summerfield, Fred A. Seaton, Robert Forsythe, True D. Morse, Dewey Short, and William E. Richards.
2. Talks by Donald A. Williams, David L. Francis, Charles W. Cooke, J. E. Sturrock, and Harvey O. Banks.
3. Addresses by James L. Bossenmeyer, Cecil H. Underwood, Herschel C. Loveless, Charles B. Shuman, and Maurice K. Goddard.
4. Group Conferences with the Army Corps of Engineers, U.S. Public Health Service, Department of the Interior, and Department of Agriculture.
5. Various questions and remarks from the floor by members at the meeting.

C. R. Gutermuth, Wildlife Managt. Inst., Washington, D.C.

Copeland, O. L. WATERSHED RESTORATION-A PHOTO-RECORD OF CONSERVATION PRACTICES APPLIED IN THE WASATCH MOUNTAINS OF UTAH. J. Soil and Water Conserv. 15: 105-120. 1960.

A classic example of restoration of damaged watersheds is the Davis County Experimental Watershed in northern Utah. This area, situated in the Wasatch Mountains between Ogden and Salt Lake City and ranging from about 5,000 feet to more than 9,000 feet in elevation, typifies the mountain-valley relationships that occur commonly throughout the intermountain West.

This restoration program started in 1933. The story of the application of successful but costly measures necessary to reestablish watershed stability and prevent destructive floods that emanated from the damaged area now known as the Davis County Experimental Watershed is presented pictorially in the following series of photographs. No floods have occurred from this area since its restoration. This attests to the efficacy of land treatments in restoring watershed stability and flood control.

Intermountain Forest and Range Expt. Sta., FS, USDA, Ogden, Utah.

Boddy, H. $11 MILLION CENTRAL SONOMA PROJECT WILL PROTECT VALUABLE FARM LANDS. Land and Water Conserv. 1(7): 14-16. 1960.

People of Santa Rosa in Sonoma county, California, will soon celebrate the groundbreaking of their $11-million-plus Central Sonoma Watershed project. The area has been hit by 12 major floods in the last 50 years, including extra damaging ones in 1937, 1939, and 1955.

Yearly flood damage losses to farm crops, homes, businesses, farmland, and utilities have averaged around $800,000. Local watershed leaders say the flood damage toll will be reduced to about $3,000 a year when land treatment and structural measures are completed six years from now.

The Central Sonoma project will be financed on a cost-sharing basis with local and federal P. L. 566 funds. The federal government's share, $9,858,900, covers the cost of flood prevention and structural works. The nonfederal share, $1,967,500 pays for land acquisitions, easements, rights of way, and relocation of bridges, roads, and utilities. Additional local money will be appropriated to maintain and operate the project over a 50-year amortization period.

Flood works include six flood-water retarding structures with a combined capacity of 5,960 acre feet; 31.2 miles of channel improvement involving straightening, shaping, riprapping and vegetating; over a half mile of channel by rain and wire revetment; 1.8 miles of concrete lined channel, and 2,000 lineal feet of streambank stabilization structures for controlling critical sediment source areas.

SCS, USDA, Berkeley, Calif.

Smith, G. BEAR HOLE WATERSHED PAY-OFF. Soil Conserv. 25: 66-68. 1959.

In March 1959, the Bear Hole watershed project in Delaware was finished. Four months later a rainstorm hit the area with the intensity expected only once every half century. Thirteen inches of rain fell in 6 days, July 10 to 15. Half of that fell between 2 A.M. and noon on July 15 after the earth had been saturated. The crop growing season was at its peak.

But Bear Hole watershed handled the deluge with an estimated crop damage of only $2,000. Farmers in unprotected areas counted up damages five times as great.

In all, 29 miles of main outlet channel were constructed, including 19 prongs leading to it. Channels were punched through miles of dense woodland. Spoil banks were leveled along the new channels and seeded with lespedeza by the State Fish and Game Department as a wildlife improvement measure.

As the new work was completed, farmers were able to improve their own farm drainage systems by tying into the prongs. Over 20 miles of farm drainage systems have been established by farmers cooperating with the Sussex County Soil Conservation District.

Fields have changed shape to follow the new drainage pattern. Hedgerows are being removed and recently abandoned fields are again part of the farm operation. Crop rotation, cover cropping, stubble mulching, and land-smoothing measures are being used by farmers as part of the overall watershed protection plan. Many of the farmers have planted wildlife food and cover plants along their field borders.

Farmers aren't the only ones benefiting from the watershed project. Floods no longer are a threat to homes in Roxana and Johnson's Corner. Improved channels keep high water off the roads. Flood damage repairs in the towns and on the roads will be reduced to a fraction of former costs.

SCS, USDA, Upper Darby, Pa.

Cline, C. E. FARMERS, CONTRACTORS TO SHARE BENEFITS OF DEEP CREEK PROJECT. Land and Water Conserv. 1(9): 6-8, 10. 1959.

Work was begun in August, 1959, on three floodwater retarding structures in the Deep Creek Watershed of Yadkin County, North Carolina. This marked the beginning of structural installation on the 75,300-acre watershed--the first in the state to let contracts for the construction of floodwater retarding dams under P. L. 566.

A total of 17 dams is to be built on the watershed within five years. The installation costs of these structures will be approximately $532,930. Also included in the structural measures for flood prevention are 39.7 miles of channel improvement, to be accomplished at an estimated installation cost of $149,252.

An additional $566,531 will be spent on land treatment for watershed protection and flood prevention. Other miscellaneous items of work bring the total cost of the project to an estimated $1,369,244, of which the Federal government's share is $823,349.

As a result of these improvements, the farmers of Deep Creek Watershed will reap total annual benefits estimated at $111,241, giving them a return of $2.70 for each dollar spent on the project.

When the project is completed annual floodwater and sediment damage on the entire watershed is expected to be reduced from an average annual cost of $177,325 to about $48,517 a year. Additional benefits will be incurred in increased yields and better land utilization. Recreation, in the form of better hunting and fishing, will be a major benefit. Annual chores such as rebuilding fences, redigging ditches, and reworking crops damaged by floods will be eliminated.

Staff Writer for Land and Water Conserv. 458 South Lawrence St., Montgomery, Ala.

Vogel, H. D. NEW APPROACH TO LOCAL FLOOD PROBLEMS. J. Hydraul. Div., ASCE 86 (HY 1): 53-61. Jan. 1960.

This paper describes the growing pressures of population and urban growth tending to increase encroachment on the flood plain, thereby increasing flood damage potential. It also reviews TVA experience in identifying flood-danger areas of cities and encouraging local action to guide urban development away from these areas.

TVA, Knoxville, Tenn.

Chambers, C. C. CONSERVANCY DISTRICTS AS FLOOD CONTROL ORGANIZATIONS. J. Hydraul. Div., ASCE 86 (HY 4): 1-9. Apr. 1960.

A well designed conservancy district is a valuable organization for developing, constructing and administering a comprehensive water management program for an intrastate watershed.

The evidence, as provided by many operating districts, indicates that this type organization is well adapted to the solution of flood problems, especially when approached on a drainage area basis. It is most applicable in the field that lies between those problems that can be solved best by existing local governmental agencies and the problems of the major rivers, which are interstate in character and in which a federal interest is predominant.

Some of the most successful flood control projects have been achieved by conservancy districts which have kept a large degree of control of the planning and operation at the local level and which have assumed a fair share of the project costs. Local project control and maintenance can be provided best if there is a conservancy district or similar organization with the legal authority and financial ability to participate in the project, even though there are large state and federal interests involved.

A conservancy district, to operate successfully, must be a political subdivision of the state, organized on a problem area basis. It must be organized at the request of and have the support of the local people. It must have authority to plan and to execute plans. It must have financial responsibility and the power to levy taxes and assessments. It must have authority to acquire property, including the right of eminent domain, and power to establish and enforce rules and regulations. It must, also, have authority to cooperate with other levels of government and their agencies.

Construction Engin., Dayton, Ohio.

McGuinness, J. L., Harrold, L. L., and Dreibelbis, F. R. SOME EFFECTS OF LAND USE AND TREATMENT ON SMALL SINGLE CROP WATERSHEDS. J. Soil and Water Conserv. 15: 65-69. 1960.

Studies on eight small watersheds at Coshocton, Ohio, showed that improved farming practices resulted on the average in smaller rates of runoff, more water absorption, less soil erosion, and greater profits. The average differences between the treatments are statistically significant. There yet remains the problem of projecting the water results downstream to larger mixed-cover watersheds.

SWCRD, ARS, USDA, Coshocton, Ohio.

Pavelis, G. A., and Timmons, J. F. LINEAR PROGRAMMING: A NEW TOOL FOR WATERSHED PLANNING. J. Soil and Water Conserv. 15: 5-10. 1960.

The approach to planning taken in the Nepper Watershed research study is most relevant to those field situations in which any measure proposed is accepted only as a provisional alternative, and a number of alternatives are evaluated for each watershed sub-area or structure site. The fact that a measure shows a favorable watershed ratio of benefits to cost merely promises a net gain to the watershed as a whole from its installation, and not even necessarily a maximum net gain for the cost involved. Moreover, without adequate compensation arrangements it could result in significant losses to some project participants and off-project areas. Research in the Nepper Watershed showed that watershed planning can proceed on a basis whereby measures are combined in such a way as to render aggregate net benefits a maximum, but subject to stated restrictions imposed by available resources, cost-sharing requirements, and the welfare condition that projects not leave anyone damaged and uncompensated.

Linear programming as a tool for formulating watershed projects derives its utility chiefly from being a systematic method for evaluating simultaneously the relative contribution of a large number of measures toward project objectives, and then checking any selected combination of measures against a number of restrictions on achieving the objectives, a number that might also be large. The fact that many of the basic functional relations between land use, watershed hydrology, and resultant benefits or costs may not be of a linear or straight-line nature does recommend against indiscriminate use of the method, but many of these difficulties can be overcome by special adaptations.

FERD, ARS, USDA, Washington 25, D.C.

Snyder, W. M. HYDROLOGIC STUDIES BY ELECTRONIC COMPUTERS IN TVA. J. Hydraul. Div., ASCE 86 (HY 2): 1-10. Feb. 1960.

Application of electronic computers in TVA watershed studies is presented. A comprehensive multiple regression analysis program for the IBM 704 computer is described. The use of this program in developing and studying hydrologic prediction equations is illustrated by discussion of numeric results of fitting two equations to data.

Hydrol. Sect., TVA, Knoxville, Tenn.

Hickok, R. B., Keppel, R. V., and Rafferty, B. R. HYDROGRAPH SYNTHESIS. Agr. Engin. 40: 608-611, 615. 1959.

For many hydrologic design problems it is necessary not only to estimate the expected peak rate of runoff, but for flood-routing purposes to synthesize the entire inflow hydrograph. In areas where few runoff data are available, the designer must resort to some method of estimating hydrograph characteristics from physiographic features of the watershed. This is particularly true in the southwestern area of the United States where such data are extremely scarce. This paper presents a method of hydrograph synthesis developed especially for small arid land watersheds.

The method involves: (1) Estimation of a characteristic lag time from readily determined watershed parameters; (2) use of the watershed lag time to predict the hydrograph peak rate for an assumed total volume of runoff; and (3) synthesizing the entire hydrograph using the lag time, the estimated peak rate, and a standard dimensionless hydrograph.

Development of the method is based on the analysis of rainfall and runoff records for 14 experimental watersheds in Arizona, New Mexico, and Colorado.

Project Engineer, Holmes and Narver Inc., Los Angeles, Calif.

Brakensiek, D. L., and Amerman, C. R. EVALUATING EFFECT OF LAND USE ON STREAM FLOW. Agr. Engin. 41: 158-161, 167. 1960.

Almost 20 years of hydrologic records are available from treated watersheds located on the Soil and Water Conservation Research Station near Coshocton, Ohio. Two-treatment levels were imposed on cultivated watersheds and one watershed was converted to a complete farm woodlot.

The technique of this study evaluated the change in streamflow by the year 1957 by utilizing a computed time trend of assumed linear form over the period of record. An index based on the runoff from watershed 196 enabled a sensitive test of significance for the estimated change and also insured that trends due to climatic elements and the general improving of agricultural technology were eliminated.

Establishment of a farm woodlot (watershed 172) greatly reduced the annual stream flow amount from this upland area, 5.32 in. by the nineteenth year.

Changes in stream-flow amounts from agronomic areas, watersheds 169, 177, and 183, were smaller, generally reduced slightly more than 1 in. by the nineteenth year. At this time only a low level of statistical significance can be placed on these changes as compared to the change under reforestation.

SWCRD, ARS, USDA, Coshocton, Ohio.

Storey, H. C. EFFECTS OF FOREST ON RUNOFF. J. Soil and Water Conserv. 14: 152-155. 1959.

The effect of the forest on runoff is dependent on the interrelationship of a large number of factors, including the type and condition of the forest, type and amount of precipitation, topography, soils and geology, and various elements of climate.

The forest differs significantly from other types of landscape. This difference is characterized by three significant elements: (1) The height of its foliage above the ground and the number of layers which compose the total thickness of this protective canopy or roof; (2) the layer of fallen leaves and other debris on the ground surface constituting the forest floor; and (3) the distinctive soils that are formed beneath forests because of the unique effects of forests upon microclimate, moisture regime, organic matter supplied, and on the animal and plant life of soil layers.

Water movement and water action are different in the forest because of the canopy, forest floor, and distinctive soils.

In order to better understand the effect of forests on runoff, it is necessary to consider the various processes that influence water movement from the time it is precipitated on a watershed until it leaves the area as streamflow or returns to the atmosphere through evaporative processes.

The following processes are described as to how the forest effects runoff: (1) Interception; (2) infiltration; (3) soil moisture-storage and movement; (4) storm runoff; and (5) water yield.

Dir. Div. Watershed Mangt. Res., FS, USDA, Washington, D.C.

Geology

Schumm, S. A. THE EFFECT OF SEDIMENT TYPE ON THE SHAPE AND STRATIFICATION OF SOME MODERN FLUVIAL DEPOSITS. Amer. J. Sci. 258: 177-184. 1960.

The percent silt-clay in sediment appears to be indicative of some physical properties of that sediment. Silt-clay is defined as that material passing the 200 mesh sieve or smaller than 0.074 mm. The shape of a stream channel cross section is found to be inversely related to the weighted mean percent silt-clay in channel banks and floor. The shape of paleochannels and their included channel-fill deposits may be similarly related to sediment type.

Observations along actively aggrading streams suggest that the stratification of channel-fill deposits may also be related to the precent silt-clay; whereas, they may be horizontal where the silt-clay content of the alluvium is small, and even convex in those channel fills with negligible silt-clay.

U.S. Geol. Survey, Denver, Colo.

Thompson, J. R. PRELIMINARY GEOLOGIC SITE EXAMINATION IN WATERSHED PLANNING. J. Soil and Water Conserv. 14: 156-159. 1959.

Geology, as applied in engineering, is an integral part of the business of watershed planning. Elements of the science of geology enter into many of the facets of planning a watershed program. The science performs an important function in the problem of the analysis of foundations and other site factors at the locations of proposed floodwater retarding structures. Dams for retarding flood flow, where used, supply a high percentage of the benefits from the reduction of downstream damages. For this reason, detention dams are widely used in watershed protection programs of the Soil Conservation Service.

The overall purpose of preliminary geologic examinations is to establish the geologic feasibility of structure sites, to provide a basis for planning detailed investigations, and to eliminate in the early stages of a watershed project as many uncertainties as possible.

It is important to review pertinent information about the watershed area in order to gain an appreciation of the broad geological aspects. From this, a summary of anticipated, specific geologic conditions can be made and this will serve as a guide for intensity of field investigations. The results of preliminary geologic examination of Lick Creek watershed in eastern Tennessee is used to illustrate this.

Geol., Watershed Planning Party, SCS, USDA, Memphis, Tenn.

Daniels, R. B. ENTRENCHMENT OF THE WILLOW DRAINAGE DITCH, HARRISON COUNTY, IOWA. Amer. J. Sci. 258: 161-176. 1960.

The changes in the Willow Drainage Ditch since 1919-20 have been reconstructed by comparison of the original profile of the ditch, historical records, and a survey of the ditch in 1958. Since construction, the drainage ditch has filled where the ditch was constructed on the Missouri River Valley. The drainage ditch in the Willow River Valley has entrenched, however, and becomes progressively deeper upstream, attaining a maximum depth of 42 feet at the Monona-Harrison County line.

The drainage ditch in the Willow River Valley apparently deepened by channel scour and headward movement of knickpoints, but in a number of entrenchments rather than a single entrenchment followed by stabilization. Once a knickpoint has passed a point in the drainage ditch, stabilization of the channel does not necessarily follow but channel scour may deepen the ditch more than passage of the knickpoint.

The filling of the lower part of the drainage ditch probably is caused by the sharp decrease in gradient of the ditch, and by coinciding periods of high water in the Boyer Drainage Ditch or the Missouri River, to which the Willow is affluent. The entrenchment in the Willow River Valley probably was produced by a constructed increase in gradient of the drainage ditch as contrasted to that of the original river gradient in the same area.

The entrenchment of the Willow Drainage Ditch has been responsible for much of, but cannot explain all of, the entrenchment of its tributary streams.

SCS, USDA, Ames, Iowa.

Wright, M. D. THE FORMATION OF CROSS-BEDDING BY A MEANDERING OR BRAIDED STREAM. J. Sedimentary Petrology 29: 610-615. 1959.

It is suggested that much cross-bedding may be formed by a current flowing at right angles to the dip of the forest laminae of the cross-bedded unit. The laminae thus represent successive positions of the depositing bank of a meandering stream. A similar origin has already been proposed for cross-bedding formed by migrating beach-gullies. Fabric analyses of cross-bedded gravel show that some units have apparently originated in this way, and published investigations of cross-bedding dip directions often show patterns that are consistent with a meander-bank origin. Much more detailed work is required before any definite pronouncement as to the extent of occurrence of this type of cross-bedding can be made.

Chelsa Col. Sci. and Tech., London, England.

Kuiper, E. SEDIMENT TRANSPORT AND DELTA FORMATION. J. Hydraul. Div., ASCE 86 (HY 2):55-68. Feb. 1960.

This paper deals with sedimentation computations that were carried out in connection with dike design for the Saskatchewan Reclamation Project. The first part of the paper gives a description of the regime of the Saskatchewan River in general and of the Saskatchewan Delta in particular. The second part presents some observations on delta formation. The third part discusses the sedimentation problems that were encountered in the design of dikes. The fourth and final part presents the method that was adopted to determine the future rate of sedimentation on the floodplains adjacent to the projected dikes.

U. Manitoba, Manitoba, Canada.

Engineering Design

Townsend, F. W., and Blust, F. A. A COMPARISON OF STREAM VELOCITY METERS. J. Hydraul. Div., ASCE 86 (HY 4): 11-19. Apr. 1960.

A description of the U.S. Lake Survey method of making stream flow measurements is given, and comparisons of current velocities simultaneously measured by cup and screw type current meters in the lower Niagara River are presented. The conclusion is reached that the two types of meters give identical results in lake survey flow measurements.

U. S. Lake Survey, Corps of Engin., U. S. Army, Detroit, Mich.

Robinson, A. R. REPORT ON MODEL STUDY OF A TRAPEZOIDAL FLUME FOR MEASUREMENT OF STREAM DISCHARGE. Colo. State U. Res. Found. CER59 ARR57 Mimeo. 24 pp. 1960.

The results of a model study on trapezoidal measuring flumes with sidewalls having very flat side slopes is reported. Originally developed for the measurement of streams having steep gradients, the flumes were studied under a variety of operating conditions. These conditions included a variation in the upstream roughness and configuration, bottom slope of the structure, and the effect of using an abbreviated design.

Many factors may effect the head-discharge relationship. Possibly the most important of these is the slope. With the bottom horizontal, changes in upstream conditions or deposits in the structure did not change the relationship. However, as the slope was increased, upstream configuration and roughness became major factors. In almost all cases, smaller deviations in the depth-discharge relationships were determined when using the depth in the lower section. One exception was the comparison of ratings depending on the absence or presence of the downstream section of the flume. In this case the change was greater when using the downstream location. With the complete flume, the effect of submergence was well defined, whereas for the abbreviated design, this effect varied with discharge.

As the slope was increased there was considerably more turbulence in the flow throughout the structure. With the abrupt transition into the flume there was an appreciable drawdown around the corners and a large fin formed in the center of the flow. There were large vortices and eddies along the sidewalls under this condition.

Although this report presents the study of a model, the results can be projected to geometrically similar structures of any size by the proper model relationships.

SWCRD, ARS, USDA and Colo. State U., Fort Collins, Colo.

Simons, D. B., and Albertson, M. L. UNIFORM WATER CONVEYANCE CHANNELS IN ALLUVIAL MATERIAL. J. Hydraul. Div., ASCE 86 (HY 5): 33-71. May 1960.

Methods of designing uniform alluvial channels are developed and illustrated. Design theories which are recommended include: (1) A modification of the regime theory of India; and (2) a modification of the tractive-force theory. Special emphasis is given to the modified regime theory. The results of this investigation are based on a field study of stable alluvial irrigation channels, and other existing alluvial channel data which are applicable.

U. S. Geol. Survey, Fort Collins, Colo.

Goodrich, R. D. TOLKMITT'S BACKWATER AND DROPDOWN CURVE TABLES. J. Hydraul. Div., ASCE 86 (HY 5): 1-6. May 1960.

Tables and formulas are presented for the computation of backwater and dropdown curves for channels of parabolic section. These are followed by cautions as to the selection of the coefficients C and n when used in connection with the computation of water-surface curves.

While not new, Tolkmitt's tables are made available to American engineers in slightly enlarged form. The use of the Manning velocity formula is recommended in selecting the necessary coefficients when adjusted as ones best judgement dictates.

Construction Engin., Grand Junction, Colo.

Martinelli, M., Jr. ALPINE SNOW RESEARCH. J. Forestry 58: 278-281. 1960.

The alpine snow research program at the Rocky Mountain Forest and Range Experiment Station has the following two major objectives: (1) To learn how much water alpine snowfields contribute to streamflow; and (2) to develop management techniques that will increase the water yield from these snowfields during the summer. In order to achieve the first objective, a survey was made of ablation (disappearance of snow due to melt and evaporation) and density at a group of alpine snowfields under summer conditions. This survey was followed by a study of the rate of evaporation and condensation at a summer snow surface. There appear to be two approaches to the second objective. One is to regulate the rate of melt by adding material to the snow surface. The other is to increase the depth and extent of alpine snowfields by the use of artificial barriers.

The storage of water in the form of high-altitude snowfields offers several unique advantages. In the first place, water is released to the streams during the period of heavy use. The prolonged melt period means a reduction in peak streamflow and a decided improvement in water quality. In addition, the water is stored at an altitude and in a form least subject to evaporation losses. Such high-altitude storage also means the water is available to all users in the watershed--not just those below the reservoirs.

Rocky Mountain Forest and Range Expt. Sta., FS, USDA, Fort Collins, Colo.

Anderson, H. W. RESEARCH IN MANAGEMENT OF SNOWPACK WATERSHEDS FOR WATER YIELD CONTROL. J. Forestry 58: 282-284. 1960.

The snowpack zone covers about 12 percent of California and is the state's principal source of water supply; the zone lies above 3,500 feet in the north and above 5,000 feet in the south. How can the forests be harvested and the vast fields of brushland and open land in this zone be managed to improve water yield? To develop some answers and test them, the Forest Service in cooperation with the State of California Department of Water Resources has 18 studies under way in the headwaters of five major California rivers.

Timber harvests are moving upward in the high-elevation true fir and mixed conifer forests. Watershed managers must learn how to cut forests and manage other land in this belt in ways that will exert control over water releases--to guard against deterioration of water supplies originating there, and to improve streamflow. We must be able to predict the consequences of various methods of managing watershed land in the snow zone in terms of increased yield, delayed yield, water quality, floods, and sedimentation.

Study areas.--California's snow management research is under way in six study areas: (1) Berkeley (project headquarters)--inventories and analysis of water yield--forest conditions and sedimentation in the snow zone; (2) Central Sierra Snow Laboratory (Yuba River,) main snow management research field station)--studies of basic meteorology, snow physics, and forest hydrology; special study of the effects of commercial logging and freeway construction on streamflow and sedimentation; (3) Onion Creek Experimental Forest (American River)--plot tests of the effects of commercial logging and of brush conversion on snow and moisture losses; calibration of five experimental watersheds for evaluation of alternative management methods; (4) Teakettle Experimental Forest (King's River)--calibration of 5 experimental watersheds to test the effect of forest cutting and grazing practices on streamflow and sedimentation; (5) Swain Mountain Experimental Forest (Feather River)--plot studies of the effects of cutting forests in strips and blocks, slash disposal, and game management on snow accumulation and soil moisture losses; and (6) Sagehen Creek (Truckee River)--plot and watershed tests to relate the effects of brush clearing and reforestation to water yield, sedimentation, and fish habitat.

Pacific Southwest Forest and Range Expt. Sta., FS, USDA, Berkeley, Calif.

Washichek, J. N. USING SNOW SURVEY FORECASTS FOR WATER PLANNING ON IRRIGATED FARMS. Soil Conserv. 25: 184-186. 1960.

It is important that an irrigation farmer know--before planting time just how much irrigation water he can depend on. Fortunately, it is possible for most irrigation farmers of the West to know approximately how much water they will have. For several years forecasts of irrigation season flow have been available for streams that depend largely on snowmelt. The water supply forecasting system of the Soil Conservation Service and cooperating agencies furnishes this information as a result of winter and early spring snow surveys. Wise farmers make use of such information in planning their farming operations; they call it water planning.

The present techniques of snow surveying and water supply forecasting are sufficiently accurate to eliminate most of the guesswork about water supply when it comes time to decide on what kind and how much of the various crops to plant. Water planning might be included as an integral part of all conservation plans for irrigated farms that depend mainly on mountain snowmelt.

Snow Survey Supervisor, SCS, USDA, Fort Collins, Colo.

Ground Water Recharge

Muckel, D. C. GROUNDWATER RECHARGE. Land Impr. 7(2): 14-17. 1960.

Natural recharge is by seepage from streams, deep penetration of rain and snowmelt into the ground, and percolation of water from hills and mountains. While the amount of water entering the underground reservoirs from these sources may vary considerably from year to year, the long-time average can be predicted with reasonable accuracy. If this long-time rate of natural replenishment is exceeded by withdrawals, then an overdraft exists and the water table lowers. This results in higher pumping costs, deepening of wells, and in some cases a complete loss of the ground water supply.

Artificial recharge of ground water to augment the natural means is being carried out in many localities and is being contemplated in many others.

Spreading diverts water to lands not ordinarily wet and thereby increases the amount of water infiltrating into the soil through greater wetted surface. Systems of spreading are similar to various systems of irrigation. They can ususlly be classified under one of the following methods: (1) Basin; (2) furrow or ditch; and (3) flooding.

Recharge by the use of pits, shafts, or wells is also practiced, although not so extensively as surface spreading. Abandoned gravel pits, old wells, or other existing holes are generally used, although shafts, pits, and inverted wells have been constructed primarily for recharge purposes. In some cases, wells that normally are pumped during the growing season are used for recharge during other seasons.

The records on the use of inverted wells for recharge are conflicting. Successes as well as complete failures have been reported.

SWCRD, ARS, USDA, Berkeley, Calif.

Schiff, L. GROUND WATER RECHARGE--NEED, PROGRESS AND RESEARCH. Calif. Irrig. Assoc. Conf. Feb. 5: pp. 63-70. 1960.

The California Water Plan and other reports of the California Department of Water Resources stress the importance of ground water reservoirs in the future development of water resources. The twelve million acre feet per year of ground water now used is more than half of the total State water use. Future development envisions much greater dependency on ground water, particularly in view of the shortage of surface storage capacity. Fortunately, large volumes of ground water storage capacity are available in regions of need.

Storage required in California to conserve and regulate the average annual runoff of seventy million acre feet and ultimate consumptive requirement of fifty million acre feet is greater than one hundred and thirty million acre feet. This is one hundred and ten million acre feet in excess of existing surface storage facilities. However, the fifty-three million acre feet of usable conservation storage needed in the Central Valley can be made up of twenty-two million acre feet of surface storage and thirty-one million acre feet of ground water storage used in conjunction with the surface storage. Surface reservoirs can regulate and desilt large flows for recharge. Ground water storage capacity can be used for cyclic carry-over storage. The conjunctive operation of surface and ground water reservoirs seeks the most economical joint yield from both kinds of reservoirs.

The present independent development of limited recharge operations with second-class or flood waters will not economically serve the ultimate water needs of the State. The ultimate need is for an average of fourteen million acre feet per year of artificial and incidental recharge in the Central Valley. This is more than five times the existing recharge.

SWCRD, ARS, USDA, Fresno, Calif.

Suter, M. ARTIFICIAL GROUND WATER RECHARGE AT PEORIA, ILLINOIS. Ill. State Acad. Sci. Trans. 52 (3&4): 96-99. 1959.

In Peoria, Illinois, ground water is obtained from glacial drift deposits varying from 10 to 200 feet in depth. In addition to municipal use, most industries also pump this water. In 1940 it was found by the State Water Survey that ground water levels were dropping about two feet per year and that the cause was over-pumpage. It was also found that the river does not contribute to the ground water storage when it is at pool level and only very little when in flood stages.

To reduce lowering of ground water levels, two principles can be used: (1) Pump less water; or (2) increase the recharge of ground water storage. Both methods have been used.

Artificial recharge can be obtained in several ways. The use of land flooding, pits, and wells was studied.

Land-flooding, as a rule, gives rates of inflow from a few inches to a maximum of five feet. The over-pumpage was calculated to be 8 to 10 million gallons per day in Peoria and there is not enough in the industrial area where the recharge is needed.

It was considered necessary to find a method which allowed a high rate of recharge over a small area. Wells or pits can be used for this purpose. Wells require clean water or they clog and are difficult to put back in operation. The cost of a filter plant and recharge wells was estimated to be about $5 million whereas the cost of a pit was approximately $100,000.

This article reports the progress made on artificial ground water recharge by use of pits.

Ill. State Water Survey, Urbana, Ill.

Irrigated and Drainage Division, ASCE. WEATHER MODIFICATION CONFERENCE. J. Irrig. and Drain. Div. ASCE 86 (IR 1): 1-151. Mar. 1960.

Papers presented at the August 1959 Weather Modification Conference in Denver, Colo. The following is a list of authors, title, and address of author of the papers presented:

Schaefer, V. J. SERENDIPITY AND THE DEVELOPMENT OF EXPERIMENTAL METEOROLOGY. Schenectady, N. Y.

Battan, L. J., and Kassander, R. Jr. EXPERIMENTS ON TREATMENT OF SUMMER CUMULUS CLOUDS. U. Ariz., Tucson, Ariz.

Smith, T. B. PHYSICAL STUDIES OF SANTA BARBARA STORMS. Meteorology Res. Inc., Pasadena, Calif.

Elliott, R. D. SEEDING OF WEST COAST WINTER STORMS. North Amer. Weather Consultants, Santa Barbara Municipal Airport, Goleta, Calif.

Howell, W. E. SEEDING OF CLOUDS IN TROPICAL CLIMATES. Lexington, Mass.

Fuquay, D. M. GENERATOR TECHNOLOGY FOR CLOUD SEEDING. Intermountain Forest and Range Expt. Sta., FS, USDA, Missoula, Mont.

Dennis, A. S. CLOUD-SEEDING RESULTS IN SANTA CLARA COUNTY. Weather Modification Co., San Jose, Calif.
Berry, F. A. ADVISORY COMMITTEE ON WEATHER CONTROL. Aerometric Res. Inc., Goleta, Calif.
Byers, H. R. THE NATURE OF CLOUD SYSTEMS. U. Chicago, Chicago, Ill.
Braham, R. R. Jr. PHYSICAL PROPERTIES OF CLOUDS. U. Chicago, Chicago, Ill.
Court, A. EVALUATION OF SEEDING TRIALS. Pacific Southwest Forest and Range Expt. Sta., FS, USDA, Berkeley, Calif.
Stout, G. E. NATURAL VARIABILITY OF STORM, SEASONAL AND ANNUAL PRECIPITATION. Ill. State Water Survey, Urbana, Ill.
Orville, T. H. A WEATHER MODIFICATION PROGRAM FOR THE FUTURE. Beckman & Whitley Inc., San Carlo, Calif.
Reynolds, R. R. THE SANTA BARBARA PROJECT. Dept. Water Res., Calif.

WATER MANAGEMENT

Irrigation

Finkel, H. J. and Nir, D. GRAVITY vs. SPRINKLING METHODS OF IRRIGATION: A COMPARATIVE STUDY. Soil Sci. 88: 16-24. 1959.

The choice of irrigation method is often determined by the objective conditions of, among others, water supply, topography, soils, and economic factors. When, however, the circumstances are such that either gravity (surface) or sprinkling methods are feasible, it is valuable to know the relative merits of these two methods insofar as the soil and the crop are concerned. For this purpose the present study was conducted in the Huleh Valley of Upper Galilee, Israel, a region of deep, rich, alluvial soil, level topography, and sufficient water supply for either pressure or surface irrigation.

The general conclusion of this study is that sprinkling irrigation is superior to gravity irrigation in a number of important respects. These include the following: (1) Yield--The yield of alfalfa was 8.3 percent higher in the first year and 12.3 percent higher in the second year under sprinkling irrigation. (2) Infiltration--The rate of infiltration on the sprinkler plots was about 3 times greater tnan that of gravity plots at the end of the first year and 6 times greater at the end of the second year. And (3) aeration--There was a highly significant decrease of aeration of the soil as a result of gravity irrigation. This may have been the decisive factor in causing the depression of yields under the gravity system.

With respect to other factors, such as volume-weight, mechanical analysis, aggregate analysis, salinity, and soil temperature, as well as moisture content, protein content of the crop, and irrigation efficiencies, there were no highly significant differences between the two methods of irrigation.

Technion, Israel Inst. Tech., Haifa, Israel.

Western Crops and Farms Management. AERATION IRRIGATION. West. Crops and Farm Managt. 9(3): 26B. 1960.

There's a new concept in sprinkler irrigation application. Called "aeration irrigation," it is a method of applying water by sprinklers based on very low application rates, approximately one-half of the normal intake rate of the soil, combined with good nozzle pressure. The application rates vary from maximums of 0.3 inch per hour on very light soils to 0.2 inch per hour on medium textured soils, 0.15 inch to 0.1 inch per hour on heavy soils. The nozzle pressured range from 40 psi nozzle sizes to and including 1/8 inch; 45 psi on nozzle sizes 9/64 inch to and including 3/16 inch; then add 5 psi for every 1/32 inch increase in nozzle size.

Generally this method requires twice as many laterals per given acreage with sets twice as long as we have heretofore considered normal. On deep-rooted crops such as cotton, alfalfa, orchards, nut crops, etc., 24-hour sets are being used in place of 12-hour sets, and on shallow-rooted crops the length of sets are generally doubled and the application rate cut in half. The results have more than offset the added equipment cost.

Results have been improved soil structure by elimination and prevention of soil compaction. These results have been found on various crops and on all types of soil and are especially true on extremely heavy soils or various soil types on which orchard and nut crops are grown, which are subject to heavy equipment when the soils are wet. All of these soils have become very friable and almost sponge-like in texture and have remained so.

Greater yields and more top quality products have also resulted from this new application method when it is combined with good irrigation practices. By good practices is meant pre-irrigation to the bottom of the root zone or to meet winter moisture, if any, also special attention to maintaining soil moisture in the upper one-third of the root zone above the wilting point at all times.

West. Crops and Farm Mangt., 4511 Produce Plaza, Los Angeles, Calif.

Fischbach, P. E., and Swanson, N. P. USE YOUR WATER EFFICIENTLY. Nebr. Expt. Sta. Q. 7(1): 7-9. 1960.

Efficient water use can mean three extra bushels of corn for every acre inch of irrigation water applied to your crop.

Water is the most important factor in corn production. Irrigation allows control of this factor of production--but to varying degrees. If you use your irrigation water efficiently, you can produce 5 bushels of corn for each acre inch of water applied, while inefficient irrigation produces only 2 bushels of corn per acre.

Efficiency in irrigation is the relationship between the amount of water delivered to the field and the amount of water actually stored in the root zones. An average irrigator will obtain an irrigation efficiency of around 50 percent, while the proper irrigation techniques will produce an irrigation efficiency of 70 to 80 percent.

Irrigation water is lost in three ways: (1) Evaporation; (2) deep percolation; and (3) runoff from irrigation.

On sandy soils with high intake rates and low water holding capacities, most of the water loss is due to deep percolation.

On clay soils, low intake rates and runoff are the major problems. It may be necessary to keep water in the furrows as long as 3 days to get moisture to penetrate 2 or 3 feet. It's not uncommon for 50 percent of the water to run off the field.

To obtain uniform water penetration on all parts of a field, the field should have a uniform grade or slope. Land grading is required on most fields, not only to get this uniformity of slope, but also to provide good surface drainage.

To apply the right amount of water at the right time, you need to know the rooting habits and water requirements of the crop.

Unless rainfall is timely, an irrigation following the last cultivation is desirable to keep the corn plant growing at its best rate. The irrigation after the last cultivation produces more bushels of corn per acre inch of water than any other irrigation during the growing season. Following cultivation and ridging, corn goes into the rapid growth stage. During this time the plant uses over 70 percent of the nutrients and water it needs during the entire season.

At about 8 weeks of age, early tassel stage, some roots will have penetrated 4 feet or more in a deep soil. However, most of the root activity will be in the top 3 feet of soil. Water penetrating below the 3-foot depth at this stage could be detrimental because of loss of immediately available nitrates.

Most of the nutrients and water are absorbed from the top 6 feet of soil. Corn roots may penetrate to a depth of 8 feet in a deep, medium textured soil.

The tensiometer is a comparatively new tool for irrigators. It provides an accurate and convenient measure of the moisture in the soil available for plant use. These instruments operate best on sandy and loamy soils, but will work satisfactorily on nearly all of Nebraska's irrigated soils. When properly installed and cared for they provide a satisfactory guide for planning irrigations and efficient water use.

A tensiometer consists of a sealed, water-filled tube equipped with a vacuum gauge on the upper end and a porous ceramic tip on the lower end. Tensiometers show "soil moisture tension" or "soil suction."

The number of tensiometers needed will vary, depending upon conditions in the field. Under favorable conditions, on land with a uniform grade and with a single soil type, use two tensiometer "stations" per field. One should be about 100 feet from the upper end of the field, the other 100 feet from the lower end.

Two tensiometers should be used per station. One at a depth of 18 inches, the other at 36 inches. The pair should be set in the corn row where the stand is normal, leaving two or three stalks of corn between the two instruments.

SWCRD, ARS, USDA and Nebr. Agr. Expt. Sta., Lincoln, Nebr.

Myers, L. E., Jr. CONSERVATION OF IRRIGATION WATER SUPPLIES IN ARID CLIMATES. Wyo. Agr. Expt. Sta. B. 367: 39-44. 1960.

The conservation of irrigation water supplies in arid climates and how the supply of water can be increased by watershed management, natural and artificial recharge of reservoirs, lining of irrigation ditches, etc. are stressed.

A conservative estimate of net losses which can be reduced appears to be in the order of 50 million acre-feet annually. Substantial increases can also be realized by other means such as increasing runoff from watersheds and reducing evaporation from irrigated fields. The development and utilization of these real and substantial opportunities can result in solution of many agricultural water-supply problems.

The future of irrigated agriculture in our arid and semiarid regions is far from gloomy. Radiant and advective energy available to plants is greater under arid and semiarid environments than under humid environments. Better control of the crop environment and better planning of farming operations are ordinarily possible, which means that a wider choice of crops to be grown is also possible. Irrigated agriculture in most of our arid and semiarid areas has great potential for highly efficient crop production. This great potential, combined with the solution of present water-supply problems, can and will make certain the continued large-scale practice of efficient irrigated agriculture in arid and semiarid environments.

SWCRD, ARS, USDA, Tempe, Ariz.

Gallatin, M. H., and Lunin, J. BRACKISH WATER FOR IRRIGATING SNAP BEANS. Peninsula Hort. Sci. Soc. Proc. 49 (5): 7-11. 1959.

Many factors must be considered when contemplating the use of brackish water for irrigation. Crops vary in their sensitivity to salinity, and frequently differences occur among varieties of a given crop. Coarse-textured (sandy) soils are less likely to accumulate salts than fine-textured soil (clays) because greater leaching occurs during winter months. Salt injury is also affected by climatic conditions. The stage of growth at which saline water is applied, as well as the salt concentration of the water, will determine the degree of injury. The study indicates that salt injury is governed by the salt content of the soil. Therefore, factors affecting salt accumulating, such as internal drainage, soil texture, etc. must be taken into consideration, Another factor governing salt accumulation is the method of application. Sprinkler irrigation distributes the salt uniformly over the surface of the soil. In furrow-type irrigation the saline water is localized in the furrows and, because of lateral moisture movement and evaporation, results in an accumulation on the ridge. High rates of fertilizer application also contribute to soil salinity. The salt concentration of the soil solution is the dominant factor in determining salt injury rather than the salt concentration of the water applied.

Farmers intending to use brackish water for irrigation must be guided by the following factors: (1) The salt content of the soil prior to irrigation; (2) the salt concentration of the irrigation water; (3) the salt tolerance of the crop to be grown; and (4) the drainage characteristics of his soil.

SWCRD, ARS, USDA, Norfolk, Va.

Fine, L. O., Williamson, E. J., Wiersma, F., and Umback, C. R. A STUDY OF THE SODIUM ADSORPTION RATIO AND RESIDUAL SODIUM CARBONATE CONCEPTS OF IRRIGATION WATERS AS THEY AFFECT EXCHANGEABLE SODIUM OF SOIL UNDER SEMIARID CONDITIONS. Soil Sci. Soc. Amer. Proc. 23: 263-266. 1959.

The object of this study was to investigate the significance of "residual Na_2CO_3," as engendered by high HCO_3-content in irrigation water, using synthetic and natural waters in greenhouse experiments, and a natural water in a field experiment. The significance is evaluated in terms of exchangeable $Na+$ changes in soils on which the waters were applied.

Synthetic waters and unadulterated natural waters of high HCO_3-content produced exchangeable-sodium-percentages (ESP) in greenhouse cultures 4 to 6% above that expected from the sodium-adsorption-ratio (SAR) value of the waters used. The use of gypsum with natural waters held the ESP to approximately 2 to 4% above that predictable from the SAR-ESP nomogram.

A field experiment of 5 years' duration with natural and gypsum-treated reservoir water under conditions of about 15 inches annual rainfall resulted in exchangeable $Na+$ levels much lower than those found in greenhouse experiments. This occurred, even though more than twice as much water was used. The highest ESP level found was 2% below that expected from the SAR value of the water.

Possible explanations are: (1) The hydrolysis of $CaCO_3$ as proposed by Bower and Goertzen; (2) the displacement of $Na+$ by $H+$ produced from the organic decomposition products, root respiration, or ionization of water; and (3) the displacement of $Na+$ by $Ca++$ mineralized from organic residues of the alfalfa crop which has occupied the land for the past 5 years.

Concerning the displacement of $Na+$ by $H+$, it was found that exchangeable $H+$ actually decreased from 2.1 me. per 100 g. of soil in 1952 to 1.5 in 1957.

Regarding Ca return by alfalfa, estimates have been made that up to 15% or more of the dry matter produced by alfalfa remains on the land after harvest. Leaf shattering and stem loss may thus be depositing 20 to 25 pounds of Ca per acre per year on the soil surface when 6 tons of hay are removed per year. One milliequivalent of exchangeable $Ca++$ per 100 g. of soil represents approximately 5% of the cation-exchange capacity; this would amount to approximately 400 pounds of Ca per acre-6 inches of soil. Thus the Ca derived from alfalfa residue could account for 25 to 30% of the difference in exchangeable $Na+$ found in the top 6-inches of soil under field conditions as compared with the greenhouse. The sloughing of root epidermal material would account for a small additional amount.

S. Dak. Agr. Expt. Sta., Brookings, S. Dak.

Langa, J. M., and Davis, J. R. SPRAY CHARACTERISTICS OF CONVERGING SPRINKLER NOZZLES. Agr. Engin. 40: 447-449. 1959.

A variety of distribution patterns were obtained through the use of impinging jets resulting from a system of three converging nozzles. In all cases, the uniformity of distribution of water was better with impinging jets than with a single circular nozzle. At the same time, the wetted radius of the impinging jets was less than a corresponding single circular nozzle. The effect of this latter result, in terms of sprinkler and lateral spacing, can be overcome by the improved distribution pattern resulting from impinging jets.

From this study it can be tentatively concluded that more uniform distribution patterns, coupled with wider sprinkler and lateral spacings can result from the use of a system of converging nozzles, thus obtaining the advantages of non-circular orifices, while retaining the advantages of circular nozzles.

Before final conclusions can be drawn, further comparisons of drop sizes and water distribution as affected by wind will be necessary to completely assess the merits of an impinging jet system of nozzles.

Jr. Author, U. Calif., Davis, Calif.

Claypoole, E. H. WHAT'S NEW WITH SPRINKLERS?...AND WHAT'S AHEAD? West. Crops and Farm Mangt. 9(3): 20, 22, 26. 1960.

Sprinkler irrigation equipment available today reflects the ingenuity of the young industry and its understanding of farming problems. The labor situations on most farms is being met through automatic systems, more power wheel units, underground main lines, automatic controls that "think", more rugged tubing and sprinkler valves, fittings, pumps, and power plants that contribute to bringing automation to the irrigation field.

The article describes the new methods including automatic systems, wheel systems, labor savers, improved fittings, safety devices, and the new giant systems.

Managing Dir., Sprinkler Irrig. Assoc.

Nielson, D. PUMPING COSTS: WHATS THE BEST POWER SOURCE? West. Crops and Farm Mangt. 9(3): 28-30, 32-33. 1960.

This article discusses overall efficiency of irrigation pumping systems and comparative advantages of using propane, diesel, gasoline or tractor fuel, natural gas, and electricity as fuel.

West. Crops and Farm Mangt., Los Angeles, Calif.

Kruse, G. SELECTION OF GRAVEL PACKS FOR WELLS IN UNCONSOLIDATED AQUIFERS. Colo. State U. Expt. Sta. Tech B. 66, 22 pp. 1960.

A series of tests was made in a radial flow model simulating a section of an irrigation well to determine the criteria for stability of uniform and non-uniform aquifers and gravel packs. Materials with uniformity coefficients from 1.3 to 2.0 were considered uniform and from 3.0 to 5.0 non-uniform.

Test results indicated the following values as the upper limits of pack-aquifer ratios if a stable filtering action was to be maintained.

Aquifer	Gravel pack	Limiting P-A ratio
uniform	uniform	9.5
non-uniform	uniform	13.5
uniform	non-uniform	13.5
non-uniform	non-uniform	17.5

The data also indicated: (1) Less aquifer movement occurs with non-uniform gravel packs than with uniform gravel packs at the same P-A (Pack to Aquifer) ratio; (2) at low P-A ratios, increasing aquifer uniformity coefficient increases initial sand movement; (3) at high P-A ratios, increasing aquifer uniformity coefficient decreases sand movement; and (4) surging reduces head loss at the interface significantly.

Colo. State U. Expt Sta., Fort Collins, Colo.

Drainage

Tuttle, R. E. DRAIN TILE--HOW ARE THEY WORKING? Soil Conserv. 25: 39-41. 1959.

Since the beginning of the Skagit County Soil Conservation District many farmers have installed tile lines year after year. SCS engineer, Maynard Parker, has prepared location maps where the assistance to farmers was part of their conservation farm plan with the district. Occasionally, tile lines had been opened to check for silting, but no over-all evaluation had been made by systematically opening many tiles that had been installed for years.

It was decided: (1) To check tile deterioration; (2) to test the acidity of the surrounding soil; and (3) to investigate the condition of the straw blanket or wood chippings around the tile after several years' use.

Wood chippings were cheaper than buying baled straw, and several farmers believed chips would last longer. Either the straw or the wood chips is considered by farmers to have two purposes: (1) Prevent fine soil particles from entering the tile joints and up tile lines; and (2) increase ability of water to find its way from the soil into the tile. Graded gravel is desirable for this, but often is expensive and hard to move to the site of the open tile ditch.

The oldest installation investigated was a clay tile line placed in 1935. Having been in operation for 23 years, no remnants of straw were visible next to the tile.

Samples of siltation material in tiles, acidity of material adjacent to the tile, and pieces of deteriorating tile were taken for analysis and study. A technical report prepared by SCS indicates, among other conclusions, that:

1. Remnants of the straw as placed about the tiles have lasted 10 years. Longer life would result if more straw were used. The straw prevented infiltration of fine material into the tile.
2. A slow deterioration of concrete tile takes place where the soil is more than mildly acid--pH 6.5. Many pieces of tile were softened sufficiently that a dull jackknife would easily loosen and remove an eighth of the original tile surface.
3. Tile lines that are submerged for a long time accumulate an organic clinging scum growth around the entire inside surface of the tile. Scum an inch thick had developed in many cases. Poor outlet ditches and the low lying position next to salt water seem to be responsible for this condition.
4. Wood chips are an effective medium to encourage inflow into the lines. The chips should be coarse. Less deterioration of these chips is evident than in the straw. In some instances there was evidence that the chips had been forced away directly over the tile during the backfilling operation. A narrower trenching machine and more generous use of the chips should correct this.

SCS, USDA, Seattle, Wash.

Walker, P., and Lillard, J. H. LAND FORMING--AN ACCEPTED DRAINAGE PRACTICE. Agr. Engin. 41: 24-27. 1960.

A study of the engineering practices and costs of the various operations required for land forming have been completed for one large field experiment. This study is located on a heavy Coastal Plain soil (Elkton vfsl) in eastern Virginia. The results show that an average of approximately six man-hours per acre are required for surveys and computations. The complete forming operations, exclusive of surveys and computations, cost approximately $61.00 per acre on this experiment. Where the land was formed in one direction only and the ridge-crop rows utilized as an integral part of the forming operation, the cost was reduced to about $34.00 per acre.

Land forming is a new practice in this area and its effectiveness and limitations have not been established. This study is being continued to measure the degree of drainage attained and the effect of the practice on crop yield and quality.

SWCRD, ARS, USDA, Blacksburg, Va.

Overholt, V. FIBER GLASS FILTERS FOR TILE DRAINS. Agr. Engin. 40: 604-607. 1959.

Silting of tile drains is a serious problem in many fine sandy soils. Covering the tile with organic material such as hay, straw, or corn cobs has been only partially successful. The effectiveness of a thin filter or screen made of reinforced glass fibers placed around the tile was determined.

The soil used in these tests was a disturbed soil. Since this is a sandy soil, disturbing it did not appreciably change the structure. Neither would the rate of free-water movement through it be seriously altered.

Rate of Silting--The average of three tests running for 88 days showed the silt accumulation in the bare tile to be 3.49 times greater than in the filter-protected tile.

Rate of Water Discharge--The rate of discharge from the fiber-glass-protected lines was 1.70 times greater than from the bare tile lines. (The average of the first three tests had 75 percent of the joint space protected.)

Silt Accumulation per Cubic Foot of Water Discharged--Each cubic foot of water entering the bare tile lines contained seven times more silt than a cubic foot of water from the fiber-protected lines (average of first three tests).

In Test No. 4 the filter was completely wrapped around the tile in one plot. The other plot had bare joints. In this test the filter gave almost complete protection against silting. The discharge from the filter-equipped plot was 2.26 times greater than from the bare-tile plot in this test.

Ohio State U., Wooster, Ohio.

Bouwer, H. THEORETICAL ASPECTS OF UNSATURATED FLOW IN DRAINAGE AND SUBIRRIGATION. Agr. Engin. 40: 395-400. 1959.

A recently developed procedure for unifying numerical analyses of water flow in entirely or partially unsaturated media of uniform or non-uniform composition (Bouwer and Little 1959) has been applied to some selected drainage and subirrigation problems to exemplify the type of problems that can be solved with the procedure and to present evaluation of the importance of unsaturated flow in these problems. Hypothetical conductivity-tension relationships were employed in most of this study. The same principles, however, can be applied in the solution of flow problems for actual soils if the particular conductivity-tension relationships are known.

A comparison of the results of the flow analyses with those obtained by approximate methods for solution indicated that reasonably accurate results can be obtained with Hooghoudt's method (1940). The applicability of approximate methods, however, is limited. The importance of unsaturated flow in the surface soil in case of subsurface drainage is demonstrated with an example whereby the capillary fringe extended into a permeable topsoil. Analyses of subirrigation flow under different conditions of internal drainage showed that the water table generally extends directly from the water level in the ditches down to the lowest water-table point midway between the ditches. Unsaturated conditions in the lower soil regions occurred only in a case of unrestricted water disposal below a permanent deep water table.

With the method for unifying solution of partially unsaturated flow systems, the subirrigation requirement of unrestricted moisture availability to plant roots could be directly expressed in terms of a maximum permissible tension at the point of lowest moisture level rather than in terms of a maximum depth of the water table.

Agr. Expt. Sta., Ala. Polytechnic Inst., Auburn, Ala.

Bouwer, H. THEORETICAL ASPECTS OF FLOW ABOVE THE WATER TABLE IN TILE DRAINAGE OF SHALLOW HOMOGENEOUS SOILS. Soil Sci. Soc. Amer. Proc. 23: 260-263. 1959.

Hypothetical conductivity-tension relationships were employed in a study to determine the effect of the thickness of the capillary fringe and the relative conductivity above the capilliary fringe on drainage flow. Solutions were obtained with an electrical resistance network using equivalent conductivities.

A capillary fringe of 50 cm. increased the drainage coefficients in shallow soil by 24 to 57%, depending on the height of the water table. Smaller increases can be expected with decreasing thickness of the fringe and increasing depth of the impermeable layer. Agreement existed between the results of the network analyses and calculated drainage coefficients, including the effect of the capillary fringe with Hooghoudt's method.

The effect of the flow above the capillary fringe on the drainage coefficient appeared to be small so that the flux across the top of the capillary fringe can be assumed to be uniform. Steady-state drainage coefficients, therefore, can be used to calculate the rate of fall of the water table after cessation of rain when the region near the top of the capillary fringe becomes a source of almost uniform flow because of drainage pore space.

For a certain water-table position midway between drains, the water table in the vicinity of the drains appeared to be higher with increasing thickness of the capillary fringe. Since hysteresis causes the fringe thickness to be greater for falling water tables than for rising water tables, lower water tables near the drains can be expected with the latter.

Agr. Expt. Sta., Ala. Polytech. Inst., Auburn, Ala.

Watson, K. K. THE APPLICATION OF DRAINAGE THEORY TO THE RADIUS AND SPACING OF DRAIN CHANNELS. J. Agr. Engin. Res. 4: 222-228. 1959.

The basic concepts involved in an understanding of the principles of the flow of water to a drain channel system are discussed with particular reference to the relationship existing between the variables. The general effect of the presence of an impermeable bed in the vicinity of the drain on the water table height midway between the drains and on the drain radius is considered for optimum conditions. The relationship which exists between the ratio of water table heights and the ratio of drain radii for the optimum condition and any other condition at the same $\frac{q}{K}$ value is utilized as the basis for an economic and practical approach to the determination of the drain radius.

U. New South Wales, Sydney, Australia.

Golding, B. L., and Low, D. E. PHYSICAL CHARACTERISTICS OF DRAINAGE BASINS. J. Hydraul. Div., ASCE 86 (HY 3): 1-11. Mar. 1960.

The physical characteristics of major significance, such as; area of the drainage-basin, slope of the principal drainage channel, length of the principal drainage channel, shape of the drainage-basin (basin shape), and general slope of the land in the basin (land slope), are reviewed and defined in terms of recent usage. A standard procedure for plotting the area-distance curves and area-elevation curves is suggested. Also discussed is a new method developed for computation of a modified area-elevation curve. Numerical procedures for computing the various important physical characteristics utilizing the standard area-distance curves and the modified area-elevation curves are included.

Hydrol. Dept., Needles, Tammen & Bergendoff, New York, N. Y.

Evaluation of Flood Water Damage

Marcus, M. G. PERIODIC DRAINAGE OF GLACIER-DAMMED TULSEQUAH LAKE, BRITISH COLUMBIA. Geog. Rev. 50: 89-106. 1960.

Tulsequah Lake, impounded by a distributary arm of Tulsequah Glacier, has been draining annually for at least 17 years and is known to have drained periodically for at least 50 years. During the dumping period icy waters escape beneath the surface of Tulsequah Glacier for about four and a half miles and finally burst forth from cavernous outlets in the ice tongue. In four or five days some 60 billion gallons of water is discharged on the Tulsequah River flood plain, most of it during a 48-hour period. Rushing waters inundate the valley, diminishing in force as they near Taku Inlet, 25 miles downstream. The destructive force of the annual outburst has become a matter of grave concern to local residents and regional planners. Disruption of activities, property loss or damage, and the ever-present threat to life and limb have all influenced the pattern of valley occupance and projected watershed development.

Tulsequah Lake occupies a steep-walled, glaciated basin between Tulsequah Glacier and an unnamed glacier originating on the upper slopes of the Devils Paw peak. The lake is about three miles long and averages about half a mile in width, narrowing to one-third of a mile at its upper, or southern, end. In 1958 the high-water mark stood 1,200 feet above sea level, and the maximum depth of the lake was about 240 feet. A moraine-dammed lake 235 feet above the 1958 water line fills most of another tributary valley. This second lake, called "Upper Tulsequah Lake," has been almost bisected by cross-valley alluvial fans. Upstream the tributary valley divides, and two small glaciers flow down from the Juneau Ice Field plateau. Surrounding this valley complex mountains rise abruptly to elevations of 6,000 to 8,000 feet. Smooth exfoliated walls characterize the lower slopes, and hanging glaciers have carved sharp arêtes and horns along the summits.

U. Chicago, Chicago, Ill.

Parsons, D. A. EFFECTS OF FLOOD FLOW ON CHANNEL BOUNDARIES. J. Hydraul. Div., ASCE 86 (HY 4): 21-34. Apr. 1960.

Some general and particular things of interest, learned in studies of stream bank stabilization methods in Western and Central New York State by the Agricultural Research Service, are given. The studies, for the most part, consist of attempts to relate observed effects of floods as evidenced by damages to stream bank revetment, to the channel geometry and the qualities of the flood flows.

SWCRD, ARS, USDA, East Aurora, N. Y.

White, G. F. STRATEGIC ASPECTS OF URBAN FLOOD PLAIN OCCUPANCE. J. Hydraul. Div., ASCE 86 (HY 2): 89-102. Feb. 1960.

A striking feature of national efforts at flood control in the United States is that in the more than two decades since a national policy was launched in 1936, the mean annual toll of flood losses has continued to rise. While at least 4 billion dollars have been spent for engineering works to reduce and control floods, the economic losses from occasional flood disaster have mounted. To understand this paradox it is necessary to examine what has been happening in the human occupance of flood plains. To find out the full import of changes in flood-plain occupance it is essential to identify those factors which enter into both public and private decisions as to flood-plain use.

This paper outlines briefly the broad problem of flood-loss reduction in the United States, reviews the findings from a recent study of changes in urban occupance of flood plains, and then suggests three strategic aspects of such occupance that seem likely to affect the results of any further engineering efforts at flood control.

U. Chicago, Chicago, Ill.

Storage and Conveyance

Timmons, F. L., and Klingman, D. L. CONTROL OF AQUATIC AND BANK VEGETATION AND PHREATOPHYTES. Water and Agr., Amer. Assoc. for Advancement of Sci. pp. 157-170. 1960.

Aquatic weeds, bank weeds, and phreatophytes are causing tremendous losses to American agriculture every year. Aquatic weeds grow submersed in, floating on, or emergent from the water in irrigation and drain canals, in reservoirs, and in farm ponds. Bank weeds grow at the waterline or immediately above with their roots extending into the saturated or moist soil. Phreatophytes grow along streams, canals, or reservoirs, and on river floodplains and habitually obtain their water supply from the groundwater table (zone of saturation) or the capillary fringe above.

The demands of our increasing population for more water for irrigation, for more and better drainage of wet lands, and for an increasing number of farm ponds have made the aquatic weed problem more acute and have made us aware of its growing importance. The increasing public awareness of the aquatic weed and phreatophyte problem along with recent spectacular advances in herbicides for evaluation have stimulated new research and action programs on control of these weeds.

Aquatic and bank weeds and phreatophytes cause losses to agriculture in many ways:

1. Floating weeds such as water hyacinth (Eichhornia crassipes) reduce the flow of water in canals as much as 40 percent while submersed waterweeds such as naiad (Najas guadalupensis) and pondweeds (Potomageton spp.) reduce the flow as much as 97 percent in extreme cases. Reduced flow makes water levels high in canals and streams and results in: (1) flooding; (2) seepage into adjoining areas or poor drainage; (3) breaks in canal banks; (4) greater losses from

evaporation; and (5) inadequate delivery of irrigation water to farms. In addition, decreased velocity of flow causes increased sedimentation, which reduces carrying capacity and makes more frequent mechanical cleaning necessary.

2. Floating weeds and other aquatic weeds that break loose obstruct weirs, gates, and other structures, and often create flood hazards, especially during storms. Also algae and fragments of other submersed aquatic weeds clog sprinklers, pumps, screens, and valves in irrigation and drainage systems.
3. Emergent aquatic weeds such as cattail (Typha spp.), bank weeds, and phreatophytes transpire tremendous quantities of water from canals, reservoirs, and the ground-water table into dry air, and thus cause serious losses in areas of water shortage.
4. Phreatophytes often obstruct river channels and flood-plains and thus prevent normal streamflow and create serious flood hazards.
5. Bank weeds and phreatophytes prevent proper inspection and maintenance of irrigation and drain canals and interfere with economic uses of farm ponds and irrigation reservoirs.

The traditional methods of controlling aquatic and bank weeds include handcutting or pulling and mechanical mowing, chaining, dragging, or crushing. These methods are still in use in many areas and in many situations but, with the present high labor costs and extensive weed infestations, they are too slow and expensive for extensive use. In most instances the hand and mechanical methods give only partial or temporary control.

New and improved methods of controlling phreatophytes (trees and shrubs) and aquatic and bank weeds are reported in this article.

CRD, ARS, USDA, Laramie, Wyoming.

Lauritzen, C. W. LININGS FOR IRRIGATION CANALS. Irrig. Engin. and Maint. 10 (1): 12-13, 21-22. 1960.

Conditioned earth linings and various types of buried membrane linings are described. The advantages and disadvantages of asphaltic lining and vinyl and polyethylene plastic films are given along with the methods of installation and repair.

SWCRD, ARS, USDA, Logan, Utah.

Vladychenski, S. A. EFFECTS OF WATER RESERVOIRS ON SOILS. Soviet Soil Sci. 9: 1006-1012. 1958.

Water reservoirs have various effects on the surrounding territory, its groundwater and soils.

Ground waters are directly and indirectly influenced by reservoirs, as follows: (1) The direct effect of a reservoir on ground water is felt over a short distance from the banks. Water infiltrates the banks at this distance when the reservoir level is high. And (2) the indirect effect consisting of pressure exerted by the reservoir on underground and surface drainwaters and the resulting rise in the ground-water table. There may be seasonal fluctuations in water level associated with precipitation, aside from the general rise. The indirect influence of a reservoir may extend quite far, perhaps as far as the water divide.

Four soil zones, variously affected by the action of reservoirs, can be separated: (1) Zone of periodic floods; (2) water logged zone; (3) meadow-like formation zone; and (4) zone of gley formation in the deeper strata. These zones are more or less clearly delimited, depending on local conditions. Sometimes the zones are combined or absent. The zone of periodic floods should be reduced to a minimum by an effective program of a reservoir's functioning.

The formation of a water-logged zone is mostly due to the direct effect of a reservoir on underground waters. The water-logged zone is delimited by elevation marks exceeding the normal pressure horizon by one meter (39.37 inches). It is usable following proper melioration measures and selection of suitable crops.

The meadow-like formation zone requires a program of special crop rotation, the list of crops consisting of water-loving plants. The zone can be used more intensively than before the construction of the reservoir. Both the meadow-like zone and the gley formation zone are formed by indirect action of a reservoir on ground waters.

The zone of gley formation in the deep horizons does not require any special treatment. The regular agronomic practices will assure good yields from soils of this group.

Amer. Inst. Biol. Sci., 2000 P St. N.W., Washington 6, D.C.

Swingle, H. S. FOR EVERY FARM A POND. Land and Water Conserv. 1(3): 6-7. 1959.

The construction of earthen dams to impound water in the United States is new and big business. Thousands of tractors and hundreds of contractors have been busy throughout the past ten years moving in excess of one billion cubic yards of soil to add approximately 1,000,000 new ponds of fresh water to our inland water supplies.

With Industry's development of the crawler-type tractor, the bulldozer, the carryall, and other modern earth-moving equipment, the stage was set for rapid progress and the results in pond construction have been spectacular. Excluding the large power-impoundments constructed on rivers, in 1935 there were in the United States only 7,885 ponds. Within the next 13 years, 1935 to 1948, approximately 140 times as many ponds were built as in the preceding two centuries, and the total number was increased to 1,111,253 ponds with a total area in excess of 529,000 acres. Since that period, pond building has continued at a steadily increasing pace. Estimates now place the total number of ponds in the United States slightly in excess of 2,000,000, with an estimated 50,000 new ponds being constructed annually.

Ponds on farms are being increasingly used for irrigation. Irrigation has been for years extensively used in the West, and its use is now expanding rapidly in the East for supplemental irrigation to increase and stabilize crop production. Thousands of new ponds will be built principally for this purpose.

Commercial production of trout, channel catfish, buffalo fish, and other species in ponds is a new but expanding business in the United States, and thousands of acres of ponds will be devoted to fish-farming within the next 25 years. Recreational needs for water will also increase rapidly with our constantly expanding population and shorter work hours.

Ala. Polytech. Inst., Auburn, Ala.

Arnold, M. H., Jr. WHAT PRICE WATER? Soil Conserv. 25: 89-90. 1959.

Yoshio Inouye built his first asphalt plank-lined reservoir in late 1957 and started a trend in better water management, improved irrigation water distribution systems, and increased crop production for his community. Within the next 18 months, 24 similar reservoirs had been built in his district, the Olinda-Kula Soil Conservation District, and one in the West Maui Soil Conservation District, both on the Island of Maui, Hawaii.

The reservoirs are designed for two major purposes: (1) To combat the water shortage at critical times during drought periods; and (2) to assist the technicians, assigned to the district, to design more efficient irrigation systems with constant pressures and quantities of water rather than the former inefficient systems with fluctuating pressures and amounts of water. Other important functions of the reservoirs are fire protection and emergency waters in case of line breaks or extremely low pressure periods.

Asphalt-plank lining is the type that has generally been installed in Kula. Other types, including hot applied buried asphalt and shotcrete (thin concrete applied with a spray gun), have also been used in Hawaii.

The 1/2-inch thick asphalt-plank material has found favor because of ease in handling and ease of installation--inexperienced help can install it with little difficulty.

The reservoirs have performed satisfactorily to date. Little or no seepage loss is apparent and evaporation losses are low in the Kula district.

SCS, USDA, Wailuku, Maui, Hawaii.

Taylor, F. THE CASE FOR LARGER FARM PONDS. Land Impr. 7(2): 8-10. 1960.

The main advantages for a large pond are: (1) Biologists have set the absolute smallest area for fish production at one-fourth acre of water surface and at least 6 foot deep (larger and deeper for colder climates). The Alabama Polytechnic Institute recommends a minimum of one surface acre for a family's fishing, and suggests that when possible, fish ponds should have 3 to 5 surface acres. (2) Irrigation from 1 to 5 acre ponds have proved successful in the Eastern United States for high value crops. (3) Water weeds, disease, and mosquitoes are less of a problem on a large pond. And (4) considering that large ponds are permanent improvements, they are a modest investment.

No address given.

Swingle, H. S. CONSTRUCTION OF PONDS FOR FISHING. Land and Water Conserv. 1(5): 24-26. 1959.

If ponds are to provide good fishing, careful planning must precede construction. Location is very important. The pond must be protected against the inflow of excessive amounts of flood waters. Care must be taken that there will not be too much or too little shallow water. The spillway must be adequately designed, not only to dispose of maximum flood waters, but also to prevent loss of large fish. A drain should be provided and installed in such a manner that the pond can be completely drained. Breeding places for mosquitoes must be eliminated. Finally, local laws relating to pond construction must be complied with.

Average runoff from watersheds of selected rivers

River	Runoff-Inches per year
Connecticut	24.3
Hudson	22.4
Potomac	13.2
Santee	17.4
Alabama and Tensaw	20.4
Tennessee	22.4
Ohio	20.1
Scioto (Ohio)	10.9
Missouri	1.5
Sabine	11.0
Colorado (Texas)	1.0
Rio Grande	0.5
San Joaquin	12.4
Sacramento	17.0
Columbia	11.4

Ala. Polytech. Inst., Auburn, Ala.

Kekko, C. F. NEW HOMES FOR WILD DUCKS. Soil Conserv. 25: 22-24. 1959.

Wild birds and animals are "taking over" scores of new farm ponds created in Upper Michigan's "Copper County" in the past 4 years. Nobody minds, though, least of all the farmers who are getting an unexpected bonus from their water storage projects.

A wave of pond construction that began in the fall of 1954, when farmers were hit hard by drought, has resulted in 137 new ponds in the Houghton and Baraga Soil Conservation Districts and Keweenaw County. They are located in the Keweenaw Peninsula, more popularly known as the Copper Country. Though constructed mainly to irrigate strawberries and potatoes and furnish water for livestock, these new water areas are being widely used by a variety of game animals and birds.

Ducks, geese, and white tail deer are most commonly seen, but other game like partridge, rabbits, muskrats, otter, and even bears, have been spotted making use of the ponds.

All these new ponds add up to 70 acres of new water surface plus a lot of good wildlife habitat in the surrounding areas. While this additional water surface was being created, no standing water of any kind was drained by landowners in applying soil and water conservation plans.

Fish are becoming plentiful too. Several of the spring-fed ponds have been planted to trout while others are used to supply bait fish for sportsmen. For some, the bait fish business is becoming a profitable sideline.

SCS, USDA, Hancock, Mich.

BASIC SOIL PROBLEMS

Soil Structure

Emerson, W. W. THE STRUCTURE OF SOIL CRUMBS. J. Soil Sci. 10: 235-244. 1959.

A model of a soil crumb is proposed in which the crumb consists of domains of orientated clay and quartz particles. A clay domain is defined as a group of clay crystals which are orientated and sufficiently close together to behave in water as a single unit. In normal agricultural soils, where calcium is the dominant exchangeable cation, the clay crystals in the crumbs are all aggregated into domains by drying. Drying to the wilting point is apparently sufficient. In the model the domains and the quartz particles may be linked to each other by organic matter or soil conditioners. The domains may also be held together by electrostatic forces. The model satisfies four conditions derived from experiment on the effect of organic matter on soil crumbs: (1) The crystalline swelling of the clay in the crumb is unaltered--the individual crystals within the domains are unaffected by organic matter and are free to take up water; (2) slaking is prevented--the strains set up in the crumb on wetting are shared between several domains through their common linkages by organic matter to quartz particles; (3) dispersion of Na-saturated crumbs is prevented--the linkages of the domains by organic matter restrain the diffuse double layer swelling of the clay; and (4) pF--moisture content curve is unaltered--the stabilization by organic matter does not require a rearrangement of the structure of the crumb.

On the basis of the model, conventional wet-sieving or dispersion tests assess the strength of the organic-matter linkages. Remoulding crumbs breaks many of the previously stable quartz-domain bonds, so that on drying and re-testing the stability of the crumbs has decreased.

The model has been shown to be consistent with present knowledge of the action of cement and lime in stabilizing soil, cement or lime being substituted for organic matter in the model. It also accounts qualitatively for the sensitivity of soils, that is the decrease in shear strength after remoulding. On the basis of the model the amount of organic matter resistant to microbial attack should be proportional to the surface area of the clay domains. Remoulding soil (or tillage) by breaking the organic-matter bonds joining the clay domains to the quartz will free organic matter for microbial attack.

This model does not apply to soil crumbs in which the crystalline swelling of the clay is prevented, for example by heat treatment.

Commonwealth Sci. and Indus. Res. Organ., Alelaide, Australia.

Emerson, W. W., and Dettmann, M. G. THE EFFECT OF pH ON THE WET STRENGTH OF SOIL CRUMBS. J. Soil Sci. 11: 149-158. 1960.

The clay-clay attractive forces were greater in crumbs from acid soils than crumbs from similar soils but containing free $CaCO_3$. This has two causes: (1) Positive charges on the edge faces of the clay crystals; and (2) exchangeable trivalent cations on the clay. Using the improved sodium-saturation method these two causes were distinguished by measuring the reduction in the strength of the crumbs by: (1) Raising the pH of the percolating NaCl to 7.4 with para-nitrophenol buffer; and (2) preliminary NaCl-HCl leaching. The effect of trivalent cations was dominant in very acid soils where Al^{+++} can exist in the soil solution. The soil conditioner 'Flotal' strengthens soil crumbs, initially at least, by substituting Fe^{+++} ions on the exchange complex. No evidence was found for cementing by precipitated $Al(OH)_3$ or $Fe(OH)_3$.

The same concentration of $CaCl_2$, $6x10^{-3}$ M was required to flocculate suspensions of moderately acid surface soils both at the natural pH of the soil and after buffering the suspensions to pH 7.4. However a Ca-illite and an acid subsoil (no organic matter) flocculated at a $CaCl_2$ concentration of $3x10^{-4}$ M at pH 5. Thus there appears to be sufficient organic matter present in normal cultivated acid soils to neutralize the positive charges on the edges of any clay particles dispersed from the crumbs.

It is suggested that, although liming an acid soil decreases the attractive forces between clay particles within soil crumbs, the presence of free $CaCO_3$ in the soil helps to maintain a sufficiently high concentration of electrolyte in the soil solution to reflocculate dispersed clay and so keep drainage waters clear.

Commonwealth Sci. and Indus. Res. Organ., Adelaide, Australia.

Martin, J. P., and Richards, S. J. INFLUENCE OF EXCHANGEABLE HYDROGEN AND CALCIUM, AND OF SODIUM, POTASSIUM AND AMMONIUM AT DIFFERENT HYDROGEN LEVELS ON CERTAIN PHYSICAL PROPERTIES OF SOILS. Soil Sci. Soc. Amer. Proc. 23: 335-338. 1959.

These studies were undertaken to determine the influence of exchangeable Ca and H and of Na, K, and NH_4 at different H levels on the aggregation of $< 50\mu$ particles and on water conductivity by a method involving compaction of the soil into the conductivity cylinders while moist. Variation of the exchangeable H of three soils (Yolo sl, Yolo l, and Hanford sl) from 0 to 85% and of the Ca from 5% to excess, exerted very little influence on aggregation, bulk density, hydraulic conductivity, or moisture retention at 1/10-, 1/3-, or 1-bar suction. Increasing Na reduced aggregation and conductivity. Increasing exchangeable K or NH_4 only slightly reduced soil aggregation but greatly reduced water conductivity. Increasing exchangeable H increased the dispersing action of Na, K, and NH_4.

U. of Calif., Citrus Expt. Sta., Riverside, Calif.

Barber, S. A. THE INFLUENCE OF ALFALFA, BROMEGRASS, AND CORN ON SOIL AGGREGATION AND CROP YIELD. Soil Sci. Soc. Amer. Proc. 23: 258-259. 1959.

The influence of alfalfa, bromegrass, and a mixture of the two on soil structure was investigated in an experiment in which each crop was grown for 1, 2, 3, and 4 years. Continuous corn was also grown. All plots were heavily fertilized in an attempt to avoid yield differences due to nutrient factors. Soil samples for physical analyses were taken in each of two years. Percentages of water-stable aggregates were determined. The aggregation index obtained by this procedure was higher after bromegrass than after alfalfa and higher after alfalfa than after corn. The alfalfa-bromegrass mixture gave a value intermediate between alfalfa and bromegrass. The aggregation index increased in a linear fashion with each additional year of bromegrass or alfalfa up to the 4 years used in the experiment. The aggregation index was not affected by the number of years of corn. Preliminary data indicate that corn yields were affected little by the aggregation index.

Purdue U., Agr. Expt. Sta., Lafayette, Ind.

Soil-Water Relationships

Gardner, W. R. DYNAMIC ASPECTS OF WATER AVAILABILITY TO PLANTS. Soil Sci. 89: 63-73. 1960.

The flow equation has been solved for the movement of water in soil to a plant root for an idealized geometry. The difference between the DPD (diffusion pressure deficit) in the plant root and the average soil suction necessary to maintain a given rate of uptake of water by the plant can be calculated and is proportional to the rate of water uptake and inversely proportional to the capillary conductivity of the soil.

The water content gradient and the suction gradient in the vicinity of a plant root remain small until the water content approaches the wilting range. The water content and soil suction in the wilting range are governed by dynamic factors.

The effect of soil suction upon plant transpiration is predicted on the bases of simplifying assumptions. The pattern of water use in a root zone depends upon the root distribution, root permeability, and upon the water retaining and transmitting properties of the soil in a predictable way.

Interpretation of water availability in terms of dynamic process is consistent with experimental observations.

U. S. Salinity Lab., SWCRD, ARS, USDA, Riverside, Calif.

Nielsen, D. R., Kirkham, D., and van Wijk, W. R. MEASURING WATER STORED TEMPORARILY ABOVE THE FIELD MOISTURE CAPACITY. Soil Sci. Soc. Amer. Proc. 23: 408-412. 1959.

With a neutron-type soil moisture meter, water stored temporarily above the field moisture capacity (FC) can rapidly and accurately be measured. Thus, the general way that the water moves from its temporarily stored condition through a soil profile can be observed. When 6 inches of water is added to profiles already at the FC, of an Ida sil, a Monona sil, a Floyd cl, and a Webster cl, one may expect to find, at the instant the last of the 6 inches seeps into the profile, if the soil conditions are as in this study--amounts of temporarily stored water (to 5-foot depth) of from 2.1 inches in the Floyd to 4.7 inches in the Monona. At a time 90 hours later the water stored temporarily above the FC will range from 0.3 inches in the Floyd to 1.5 inches in the Webster.

The temporary storage characteristics of these profiles as observed in the field can be explained on the basis of laboratory determinations made on core samples taken from the field locations. The field and laboratory measurements show that the Webster and Floyd have an aeration problem especially if there is water temporarily stored above the FC. The Monona develops an aeration problem but only in the surface 6 inches when water becomes stored there in excess of the FC. At no time, and at no depth, and whether with or without temporarily stored water, was the Ida profile observed to have an aeration problem.

U. of Calif., Davis, Calif.

Brown, P. L. YOU CAN PREDICT CROP YIELDS, PLAN FERTILIZER APPLICATIONS BY USE OF A SOIL MOISTURE PROBE. Mont. Farmer--Stockman 1 p. Mar. 15, 1960.

In dryland areas and particularly in the Great Plains, crop yields are usually related to the amount of stored moisture at planting time. Recent experiments in the Corn Belt also have shown the importance of stored moisture for corn and other crop production.

There is need for a device that can be used to determine depth of moisture penetration in the field in dryland areas where soil moisture limits plant growth. Irrigators also need a simple device to determine effectiveness of irrigation.

A soil moisture probe has been developed which is useful in easily and quickly determining soil moisture depths. The probe penetration will normally be stopped by a dry layer of soil. Rocks and coarse gravel will stop the probe but are easily detected. The depth of penetration is usually the depth of moist soil. The moisture content of the sample can be determined by its appearance and feel.

SWCRD, ARS, USDA, Bozeman, Mont.

Ogata, G., Richards, L. A., and Gardner, W. R. TRANSPIRATION OF ALFALFA DETERMINED FROM SOIL WATER CONTENT CHANGES. Soil Sci. 89: 179-182. 1960.

The transpiration of alfalfa in the field during summer was determined during a 50-day interval, following irrigation by measuring soil-moisture depletion. Root-length measurements were also made. Data are given for transpiration, and also for water flux density into roots, as a function of time and depth in the profile. The data indicate that for a time following irrigation, transpiration is determined largely by weather, but the shifting flux pattern in the soil-root system, with attendant increases in suction gradients, gradually become increasingly limiting as soil moisture becomes depleted, and, as a consequence, transpiration rate continuously decreases.

U. S. Salinity Lab, SWCRD, ARS, USDA, Riverside, Calif.

Mazurak, A. P., Kriz, W., and Ramig, R. E. RATES OF WATER ENTRY INTO A CHERNOZEM SOIL AS AFFECTED BY AGE OF PERENNIAL GRASS SODS. Agron, J. 52: 35-37. 1960.

Four years of grass in a rotation on a chernozem soil substantially increased the rate of water intake into soil over that of grain-fallow sequence. Application of nitrogen fertilizer did not affect the rates of water entry into soil.

Plots cropped for 8 years to grasses approached the soil structural condition of plots in grass for 20 years. Four years of grass in a rotation substantially decreased the ratio over that of the grain-fallow sequence. Other properties associated with soil structure showed that bulk density of the surface 3 inches of soil was significantly decreased by the increase in age of grass stand; the differences in the percent air-filled pores at 60-cm. tension or at field capacity were not statistically significant. Total nitrogen content and total oxidizable organic matter in the surface horizon increased with the age of grass stand, but only the total nitrogen content of soil was increased by the application of nitrogen fertilizer.

Nebr. Agr. Expt. Sta., Lincoln, Nebr.

Carlson, C. A. APPROXIMATION OF THE FIELD MAXIMUM SOIL MOISTURE CONTENT. Soil Sci. Soc. Amer. Proc. 23: 403-405. 1959.

Field maximum moisture content is defined as the recurring maximum moisture content of a soil layer in its natural position. An approximation of the field maximum is needed when daily moisture records are not available for selecting the recurring peak values. This paper presents the approximation of the field maximum moisture content for equations relating various soil and site properties.

Of the several factors investigated, the 0.06-atm. soil moisture tension value was the only single factor that correlated significantly with the field maximum; it accounted for about 68% of the variation in the field maximum values. With a simultaneous analysis, the sand content and the wetness index of the soil layer also were found to be primary factors in estimating the field maximum moisture content. Wetness index is an arbitrary classification that rates the potential maximum wetting of the 0- to 12-inch layer of soil and is dependent on the depth to a water table and the depth of wetting. Organic content and clay content were found to be secondary factors in the 0- to 6- and 6- to 12-inch layers, respectively. Equations using all factors accounted for about 80% of the variation in the field maximum values. The usefulness of the equations was evaluated by application to 533 sites located throughout the United States.

Southern Forest Expt. Sta., FS, USDA, Vicksburg, Miss.

Sudinitsyn, I. I. EFFECTS OF FUNCTIONAL SOIL MOISTURE PROPERTIES ON THE RATE OF MOISTURE UPTAKE BY WOODY PLANTS. Soviet Soil Sci. 11: 1247-1254. Nov. 1958.

The availability of soil moisture to woody plants is directly related to the suction force of the roots, the negative pressure of the soil moisture, and the conductivity of the soil moisture. The relationship between these magnitudes is expressed by the formula

$$v = -K. \frac{dH}{dl} \left[\frac{cm}{sec}\right],$$

where v $\left[\frac{cm}{sec}\right]$ is the rate of moisture flow towards the absorptive surface of the roots,

$\frac{dH}{dl}$ $\left[\frac{barye}{cm}\right]$ is the gradient of the negative pressure close to this surface, and K $\left[\frac{cm^3, sec}{g}\right]$ is the coefficient of moisture conductivity of the soil.

With a gradual decrease in the soil moisture content, the negative pressure of the moisture and the coefficient of moisture conductivity decrease rapidly. The relationship between these magnitudes is expressed, to the first approximation, by the inverse quadratic ratio ($K = k. H^{-2}$).

With a decrease in the moisture, the suction force of oak roots gradually increases, at first slowly and then more rapidly; this results in the development of a considerable negative pressure gradient close to the absorptive surface.

This increase in the gradient makes it possible to maintain a high rate of moisture flow, in spite of a decrease in the moisture conductivity of the soil. When a certain physiological limit is reached, however, (for drought-resistant forms of oak this is in the interval between 30 and 40 atmospheres) the suction force ceases to grow, the gradient of the negative pressure drops rapidly, and the moisture flow toward the roots gradually fades away.

Amer. Inst. Biol. Sci., 2000 P St. N.W., Washington 6, D.C.

Lime

Sanchez, C., and Kamprath, E. J. EFFECT OF LIMING AND ORGANIC MATTER CONTENT ON THE AVAILABILITY OF NATIVE AND APPLIED MANGANESE. Soil Sci. Soc. Amer. Proc. 23: 302-304. 1959.

A large amount of the soluble Mn added to soils was rapidly converted to nonexchangeable forms in both incubation and field studies. The addition of lime further decreased the amount of exchangeable Mn (NH_4OAc-extracted). The acid-extractable Mn content of the soil showed no decrease at the end of 3 weeks' incubation but did after 6 weeks' incubation.

The moisture content of the sample previous to extraction had an effect on the exchangeable Mn content. Less exchangeable Mn was extracted when the soil was kept moist after the sample had been taken than when it was first air-dried. This effect was most pronounced on a high organic matter soil which had been limed.

The addition of peat to a low organic matter soil increased the exchangeable Mn content of the acid soil when maintained in a moist condition. The peat caused a decrease in the acid-extractable Mn in the limed soil.

Paper No. 958 J. Ser., N.C. Agr. Expt. Sta., Raleigh, N.C.

Army, T. J., and Miller, E. V. EFFECT OF LIME, SOIL TYPE, AND SOIL TEMPERATURE ON PHOSPHORUS NUTRITION OF TURNIPS GROWN ON PHOSPHORUS-DEFICIENT SOILS. Agron. J. 51: 376-378. 1959.

Two soils, Georgeville sicl and Bladen fsl, were used in pot tests to determine the interaction effect of liming and soil temperature on phosphate availability. Turnips were grown as the test crop. Lime applications resulted in larger plants on both soils. Phosphorus uptake calculations showed a significant release of unavailable soil phosphorus favored by higher pH values and higher soil temperatures. Extraction of the soils indicated that a buildup of acid-soluble phosphorus had occurred in the limed pots. It appears that both the percent calcium saturation and the soil temperatures should be considered in evaluating soil tests for phosphorus by acid extraction.

J. Paper 957, N.C. Agr. Expt. Sta., Raleigh, N.C.

Sullivan, E. F., and Marriott, L. F. EFFECT OF SOIL ACIDITY ON ESTABLISHMENT AND GROWTH OF ORCHARDGRASS SEEDLINGS IN POT CULTURES. Agron. J. 52: 147-148. 1960.

With increasing emphasis on the production of nitrogen-fertilized grass pasturage, measurements should be made concerning the sensitivity of improved grasses to pH level especially under moderate to heavy rates of fertilizer nitrogen. This study was made to determine the establishment responses of three varieties of orchardgrass to soil pH level. In addition, the effect of lime on the composition of herbage was evaluated.

Establishment of orchardgrass, as determined by yield of top-growth, was most rapid at pH 6.7. Herbage quality was improved by the addition of lime to soil testing pH 4.7. Root weights decreased with increasing pH levels above pH 5.3. Pennlate orchardgrass did not become established at pH 4.7; but, the addition of 1 ton of lime per acre (pH 5.3) overcame this adverse condition.

Under the conditions of this test, S-37 orchardgrass produced higher total plant yields than Pennlate or Potomac orchardgrass.

Pa. Agr. Expt. Sta., University Park, Pa.

Kay, B. L. LIMESTONE PELLETING OF SUBTERRANEAN CLOVER TESTED ON ACID SOILS. J. Range Mangt. 12: 205-207. 1959

Two kinds of legume inocula and two methods of applying limestone were studied as aids to the field establishment of subterranean clover on four acid range soils having pH values of 4.6 to 6.0. A commercial inoculum intended for subterranean and crimson clovers, and soil inocula proved equally effective on three of the sites, but the soil inoculum used in one experiment was definitely harmful, drastically reducing stand.

Limestone pelleting was of questionable benefit as an aid to rhizobial inoculation on these acid soils, even though subterranean clover forage responded substantially to inoculation on all four soils. The heavier concentration of limestone provided by the band treatment resulted in a positive yield response in association with commercial inoculum on the most acid soil (pH 4.6).

U. Calif., Davis, Calif.

Harper, H. J. THE EFFECT OF LIME AND VARIOUS FERTILIZERS ON WINTER BARLEY IN A ROTATION WITH SWEET CLOVER. Okla. State U. Expt. Sta. B. B-559, 12 pp. 1960.

The effect of various fertilizers on the yield of winter barley grown in a 4-year rotation with sweet clover on Norge l was studied on the Oklahoma Agricultural Experiment Station's Perkins Farm from 1937-57. The average yield of barley was increased by all fertilizer treatments.

The increase in barley yields obtained from 1937 to 1940 from plots where different fertilizers were applied before sweet clover was grown on them was similar to increases obtained after sweet clover had been grown except on plots fertilized with lime and rock phosphate.

Before the sweet clover was grown, the average yield of barley on the plots fertilized with lime and rock phosphate was only 0.2 bushel more per acre than was obtained on the limed plot, as compared with 6.9 bushels of grain per acre from plots fertilized with lime and superphosphate. After sweet clover residues were returned to the soil, the average yield of barley on plots where lime and rock phosphate were applied was 8.4 bushels per acre higher than on plots treated with lime alone.

The average yield of barley where sweet clover residues were returned to plots fertilized with lime and superphosphate was 9.1 bushels per acre. Lime and manure plus sweet clover residue produced an average barley yield that was 9.3 bushels higher than the yield obtained on the limed plot. Superphosphate, manure, and limestone only produced 1.0 bushel more barley per acre than was obtained on plots fertilized with lime and manure.

The yield of barley clippings obtained in late March on plots fertilized with superphosphate and lime for the 7-year period, 1944-50, was more than three times as high as that produced on unfertilized soil and 21 percent higher than that obtained on plots fertilized with rock phosphate and lime.

The average yield of barley planted in 14-inch rows to obtain a better stand of sweet clover on plots fertilized with manure, lime, and superphosphate was 24.1 bushels per acre the third year after sweet clover as compared with 26.7 bushels per acre from barley planted in 7-inch rows the second year after sweet clover, for the 21-year period.

A similar reduction in the average yield of barley planted in 14-inch rows as compared with 7-inch rows was obtained on limed plots fertilized with superphosphate or rock phosphate, alone and with manure. The root system of barley plants does not efficiently utilize all the soil space in 14-inch rows.

Information is presented on the yields necessary to meet costs of planting, harvesting, and fertilization.

Okla. State U. Expt. Sta., Stillwater, Okla.

Ragland, J. L., and Coleman, N. T. THE EFFECT OF SOIL SOLUTION ALUMINUM AND CALCIUM ON ROOT GROWTH. Soil Sci. Soc. Amer. Proc. 23: 355-357. 1959.

The effect of lime level on the growth of grain sorghum roots into subsoils of the Norfolk catena (Norfolk, Goldsboro, Lynchburg, Rains, Portsmouth) was studied in a greenhouse experiment. The effects of lime and KCl on root growth of sweet corn and on soil solution concentrations of Al were investigated in a second greenhouse experiment. The latter was pursued further by growing grain sorghum plants in suspensions of White Store c to which had been added various quantities of $Ca(OH)_2$ and $CaCl_2$.

The growth of roots into unlimed subsoils from the Norfolk catena was related inversely to the amounts of exchangeable Al. The percentage Al-saturation of the catena members increased with decreasing natural drainage. Root growth into the subsoils increased substantially when lime sufficient to cause hydrolysis of the exchangeable Al was added.

The addition of KCl to unlimed Creedmoor, Portsmouth, and Appling soils increased the concentration of Al in soil solution to the point that growth of sweet corn roots was drastically reduced. When lime was added, corn roots grew well even at the highest level of KCl.

The development of roots by grain sorghum plants grown in suspensions of acid White Store c (30 me. exchangeable Al per 100 g.) was restricted severely unless 80% of the acidity was neutralized. This was particularly true for the highest rate of $CaCl_2$.

N.C. Agr. Expt. Sta., Raleigh, N.C.

Soil Chemistry

Nelson, L. A., Kunze, G. W., and Godfrey, C. L. CHEMICAL AND MINERALOGICAL PROPERTIES OF SAN SABA CLAY, A GRUMUSOL. Soil Sci. 89: 122-131. 1960.

The San Saba profile, developed in marine sediments, consist of a thick, noneluviated, very dark gray to black a horizon of calcareous to neutral, very plastic clay, very gradually grading into an olive gray compact, nearly impervious C horizon which consists of Lower Cretaceous marly clay or marl that is often interbedded with thin seams of limestone. The depth of the solum varies with position in the original pit-and-mound gilgai micro-relief, ranging from less than 2 feet to 5 or 6 feet. Mineralogical and chemical studies show the San Saba clay of the Grand Prairie region of central Texas to be a typical grumusol in terms of the concept proposed by Oakes and Thorp (1951).

The average clay ($< 2\mu$) content of the horizons common to all three profiles ranges from approximately 42 percent in the C to 51 percent in the A_{12}. The average silt content is slightly lower in the solum and for the profiles ranges from 52 percent in the C to 43 percent in the A_{12}. The percentage of $< 0.2\mu$ clay of the total clay fraction ranges from 61 to 84 percent.

The presence of free $CaCO_2$ in all horizons, except the A_{1p} horizons averages 3.5 percent. The average cation-exchange capacities for the profiles range from 50 me./100 g.

in the A_{1p} to 30 me. /100 g. in the C. The decrease in cation-exchange capacity with depth is primarily due to the increase in the content of $CaCO_3$. Exchangeable magnesium and potassium are low and generally decrease with depth, whereas, exchangeable sodium shows no consistent trend and varies widely within a given profile.

The clay fractions ($<2\mu$, $<0.2\mu$) are dominated by montmorillonite; the kaolinite content is variable, however, and generally increases with depth in Profiles 1 and 2. Lesser amounts of illite and quartz are also reported for the $<2\mu$ fraction. The sand and the silt fractions are composed primarily of quartz.

On the basis of mineralogical and chemical evidence it is concluded that the major changes that have occurred in the course of soil formation are loss of carbonates and accumulation of organic matter in the upper portion of the profile.

J. Paper 3274, Tex. Agr. Expt. Sta., College Station, Tex.

Allen, V. T., and Jones, W. D. CLAYS AND CLAY MINERALS OF NEW ENGLAND AND EASTERN CANADA. Geol. Soc. Amer. B. 71: 75-85. 1960.

Clay minerals were collected from shales and clay deposits in New England and Eastern Canada ranging in age from Precambrian to Recent. The collection was made to include representative clay minerals of each district, geological period, and environment. Fifty-six samples were selected for detailed petrographic and X-ray study.

The potash clay minerals, or hydrous micas, and chlorite or vermiculite are the abundant clay minerals in the marine shales and clays in nonmarine varved clays, and in glacial tills examined from this region. The presence of potash clay minerals and chlorite is not a reliable indication that the sediment containing them accumulated in a marine environment. Varved clays deposited in lakes have the same clay-mineral composition as clays containing Quaternary marine fossils and Paleozoic marine shales in the same area. Therefore, the source area from which the clays were derived had a more pronounced influence on the clay-mineral composition of the resulting sediment than did the environment in which the clay-minerals were deposited.

The clays and shales in which the fossils and structures indicate a nonmarine environment of deposition have abundant kaolinite. The kaolinite was eroded from a land area where kaolinite clays were present. Two types of kaolin was formed by surface weathering in New England probably during the Teriary. Replacement kaolin was formed by hydrothermal solutions in Quebec during Precambrian time.

Inst. Tech., St. Louis U., St. Louis, Mo.

DeMumbrum, L. E. CRYSTALLINE AND AMORPHOUS SOIL MINERALS OF THE MISSISSIPPI COASTAL TERRACE. Soil Sci. Soc. Amer. Proc. 24: 185-189. 1960.

Vermiculite and "allophane" are predominant clays of poorly drained Gulf coastal soils, while vermiculite and gibbsite are found in the better drained soil studied. Vermiculite present in both situations is interlayered with alumina, somewhat similar to that described by Rich in Virginia soils. Removal of the interlayer alumina allows collapse of the mineral, but no expansion beyond 14Å. The ability to fix large amounts of K was also induced by the treatment, indicating the vermiculitic nature of the mineral.

The presence of an amorphous, aluminous mineral was evident from the nature of the X-ray diffraction patterns, chemical analyses, and from electron photographs. The most direct means for its determination, however, was the use of an infrared absorption technique. A very strong 2.78 micron hydroxyl absorption maximum was observed in the colloid containing large amounts of alumina. The intensity of the absorption maximum was lessened as amount of the substance decreased.

Presence of these clays in soils derived from Recent or late-Pleistocene marine sands may be explained by either of two alternate hypotheses: (1) Glauconite weathering; or (2) deposition of weathered micas in the presence of aluminous precipitate in semi-marine environment. Either or both processes may have been operative.

SWCRD, ARS, USDA, Beltsville, Md.

Bower, C. A. CATION-EXCHANGE EQUILIBRIA IN SOILS AFFECTED BY SODIUM SALTS. Soil Sci. 88: 32-35. 1959.

A satisfactory expression of cation-exchange equilibrium is of considerable value in the study of soils affected by sodium salts. Such an expression permits estimation of the exchangeable sodium percentages of soils from analysis of their equilibrium water extracts. It is also useful for predicting changes in exchangeable-sodium percentages upon application of irrigation waters of known composition to soils.

Experimental data for soils and clays having surface charge densities of 1-2 X 10^{-7} me/cm. are presented, which show that cation-exchange equilibrium in the Na-Ca system is satisfactorily described by the Poisson-Boltzmann differential equation of the electrical double-layer as derived by Eriksson. This indicates that the relative adsorption of Na and Ca is largely a consequence of the valency of the cations. In agreement with Bolt, it was found that Gapon's equilibrium equation closely approximates the equilibrium equation derived by Eriksson until ratio of adsorbed Na to adsorbed Ca exceeds 1.5 or 2. Moreover, it is shown that Gapon-type equations are of practical value even in systems containing Mg and K as well as Na and Ca.

U.S. Salinity Lab., SWCRD, ARS, USDA, Riverside, Calif.

Kaurichev, I. S., Kulakov, Y. V., Nozdrunova, Y. M., and Timiryazev, K. A. FORMATION AND MIGRATION OF ORGANIC IRON COMPOUNDS IN SOIL. Soviet Soil Sci. 12: 1307-1313. Dec. 1958.

This article presents results of a three-year observation of the dynamics of oxidation-reduction in sod-podzolic soils, as well as data on laboratory experiments to determine the possibility of the formation of organic iron compounds during the course of temporary reducing processes in the soil.

The authors draw the following conclusions: (1) In soils with temporary excess moistures, reducing processes appear during the spring that lead to the formation of ferrous iron. (2) The ferrous iron, reacting with water-soluble organic substances, forms complex organic iron compounds. Upon later oxidation of the iron these compounds maintain a high stability and the ability of migrating through the soil. And (3) there is a possibility of the formation of complex organic iron compounds under the conditions of the formation of podzolic and bog soils, as well as soloths, solonetz, and depression podzolized soils.

Amer. Inst. Biol. Sci., 2000 P St. N.W., Washington 6, D.C.

Schnitzer, M. INTERACTION OF IRON WITH RAINFALL LEACHATES. J. Soil Sci. 10: 300-308. 1959.

Leachates from decomposing leaves of four species of deciduous trees were collected after each rainfall during the months of May to September. Determinations were made of the capacity of these leachates to take up iron from iron-saturated Dowex-50 and to withhold this iron from exchange and/or adsorption by exchange resins saturated with H, Al, Ca, and Mn. For both characteristics the leachates ranked maple > poplar > birch > beech. The capacity of ionsaturated resins to remove iron from iron-enriched leachates was as follows: H > Al > Ca = Mn. This behavior may be related to the variable thicknesses of the horizons of eluviation and deposition of iron in various podzolic soils. These horizons are, in general, thinner in the strongly acidic Podzol soils than in Grey-Brown Podzolic soils more highly saturated with calcium.

Potentiometric titrations of metal-free and iron-enriched leachates indicated that titratable acid groups were blocked by the added iron. Apparent pK values of metal-free leachates ranged from 3.^{6} to 3.^{9}, those of iron-enriched leachates, except poplar, from 4.^{7} to 5.^{0}.

Canada Dept. Agr., Ottawa, Ontario, Canada.

Lindsay, W. L., Peech, M., and Clark, J. S. DETERMINATION OF ALUMINUM ION ACTIVITY IN SOIL EXTRACTS. Soil Sci. Soc. Amer. Proc. 23: 266-269. 1959.

A method is presented for calculating the Al^{3+} ion activity from measurements of the concentration of Al, pH, and the ionic strength of the soil extract. The colorimetric method for determining the concentration of Al in soil extracts makes use of the aluminum reagent with provisions for removing organic matter and silica and for preventing the interference of Fe by the addition of thioglycollic acid.

The validity of the method was established by verifying the existence of a theoretical equilibrium relationship between the Al^{3+} and the H^+ activities in soil extracts. The value of (pH--1/3 pAl) for $CaCl_2$ extracts of three acid soils was found to remain remarkably constant as the concentration of $CaCl_2$ in the extracting solution was increased from 0.001 to 0.10M. This constancy of (pH--1/3 pAl) for soil extracts can be predicted from the Donnan and Gouy theories and does not necessarily indicate the presence in the soil of some crystalline form of hydrous aluminum oxide having a definite solubility product.

Agron. Paper #454 N.Y. State Col. Agr., Cornell U., Ithaca, N.Y.

Yuan, T. L. DETERMINATION OF EXCHANGEABLE HYDROGEN IN SOILS BY A TITRATION METHOD. Soil Sci. 88: 164-167. 1959.

Two procedures were developed for the determination of exchangeable hydrogen, using fluoride to complex hydrolyzable aluminum exchanged from the soil: one is for the direct titration of exchangeable hydrogen; and the other includes the determination of exchange acidity and of aluminum. In the latter procedure the hydrogen value is calculated by difference. Both procedures are simple and rapid and provide a reasonable estimate of exchangeable hydrogen within ranges normally encountered in the soil. If iron is present in an appreciable amount, a correction should be made.

Fla. Agr. Expt. Sta., Gainesville, Fla.

Nelson, J. L., Boawn, L. C., and Viets, F. G., Jr. A METHOD FOR ASSESSING ZINC-EXTRACTABLE ZINC AND "TITRATABLE ALKALINITY" VALUES. Soil Sci. 88: 275-283. 1959.

A laboratory method for distinguishing between zinc-deficient and zinc-nondeficient soils for field crops is presented. The method consists of plotting acid-extractable zinc against the "titratable alkalinity" of a soil, which is defined as the me. of acid required to titrate the soil to pH 5.0. A good separation of zinc deficient and zinc nondeficient soils was obtained with soils from seven western states of the United States, indicating that the method may be applied as a tool in the diagnosis of zinc deficiency.

Sci. Paper 1698. Wash. Agr. Expt. Sta., Pullman, Wash.

Hester, J. B. WHAT IS REQUIRED FOR A COMMERCIAL CONSULTING AND SOIL-TESTING SERVICE. Agr. and Food Chem. 8(2): 99-100. 1960.

In conducting a commercial laboratory, factors to be considered are: accuracy of soil analyses, type of extractant and interpretation of results, nutritional elements involved, the specific soil problems of concern, and achievements expected. With these data available and a broad knowledge of soil, plant, and animal mineral nutritional requirements, the laboratory is well on its way toward success.

Agr. Res. Lab., Elkton, Md.

Schrader, L. L. OPERATION OF A SOIL-TESTING AND RECOMMENDATION SERVICE IN A PLANT FOOD SALES PROGRAM. Agr. and Food Chem. 8(2): 100-101. 1960.

Soil testing has definite value--to the dealer and the customer. However, experience has shown also that the report on the soil test must be expressed in simple terms so the farmer can understand its meaning. By having the report sent to the dealer or salesman, a twofold purpose is accomplished. After discussing the farmer's soil requirements, both know what fertilizer materials are needed to raise the desired bushels per acre. And after following recommendations the farmer knows the soil-testing program really works.

Standard Oil Co., 910 So. Mich. Ave., Chicago 80, Ill.

Wolf, B. COMMERCIAL LABORATORY AND ADVISORY PROCEDURES IN SUBTROPICAL AGRICULTURE. Agr. and Food Chem. 8(2): 96-99. 1960.

Advisory systems based on soil and plant analysis are of great value in subtropical agriculture. Considerable attention must be paid to trace elements because of light soils and extreme leaching. The combination of soil and climate necessitates sampling on a 2-week schedule for soils producing vegetables, gladioli, chrysanthemums, and other plants having limited food storage capacity. A much less frequent schedule (three to four times per year) is needed for citrus, cane, pasture, sod, and other perennials.

Dr. Wolf's Agr. Lab., Hollywood, Fla.

Kamprath, E. J., and Fitts, J. W. INTERPRETATION OF SOIL TESTS AND APPLICATION AS CHARTED BY CURRENT RESEARCH. Agr. and Food Chem. 8(2): 94-96. 1960.

Information gained from soil testing is used in many ways. Some of the more important objectives include: (1) To group soils into classes for suggesting fertilizer and lime practices; (2) to predict the probability of getting a profitable response to the application of plant nutrients; (3) to help evaluate soil productivity; and (4) to determine specific soil conditions which may be improved by addition of soil amendments or cultural practices.

A big problem in soil-test interpretation and recommendations is how much fertilizer should be applied. Although crops vary in their nutrient requirements, the addition to the soil of amounts equivalent to those absorbed by the plants is not valid, because only a portion of the applied fertilizer will be utilized. The remainder may be lost by leaching or made immobile by fixation. The release of nutrients from the soil must also be taken into consideration.

The addition of fertilizers and lime to the soil changes the immediate environment of the plant roots. Although a large increase may be obtained from application of a fertilizer to a soil low in a given element, the yield obtained is not likely to approach that obtained on a "fertile" soil.

Interpretation of soil-test results and recommendations become a question of how to improve the fertility status of the soil. How much fertilizer will be needed to change the soil from low to medium or high in that element? What soil factors will influence the amounts of fertilizer required? What will be the most economical level at which to maintain the nutrient status of the soil? Many factors will influence the possibility of building and maintaining high nutrient levels.

The relative phosphorus-fixing capacities of soils can be determined by laboratory methods.

Once this information is available, the soils of an area can be grouped according to their relative phosphorus-fixing capacities, and recommendations for phosphorus fertilization can be made.

The available potassium content is another important factor in evaluating the fertility level of a soil. The availability of potassium in a given soil for annual crops is related in large part to the amount of exchangeable potassium, which is the form generally measured by a soil test. The ability of a soil to supply potassium over a long time, however, depends upon the amount of non-exchangeable potassium present. Therefore, in evaluating the potassium status of a soil the level of both exchangeable and nonexchangeable potassium must be considered.

In making recommendations based on soil tests it is important to consider what is happening to the fertility level of the soil as well as the nutrient requirements of the crop.

The level to which potassium can be built in a soil depends upon the cation exchange capacity and the cations present on the exchange complex. Generally, the higher the cation exchange capacity, the larger is the reservoir in which potassium can be stored. Therefore, it is usually possible to build the available potassium content of soils with a high cation exchange capacity to a higher level than those of a low capacity.

Plants differ as to the optimum pH and lime level necessary for good growth. Therefore, it is necessary to consider the kind of plant to be grown as well as the chemical properties of the soil when making lime recommendations for acid soils.

N. C. Agr. Expt. Sta., Raleigh, N. C.

Hanna, W. J., and Flannery, R. L. CURRENT NEW JERSEY RESEARCH IN CHEMICAL SOIL TESTING. Agr. and Food Chem. 8(2): 92-94. 1960.

Correlation studies are being made between nutrient extraction by electrodialysis and plant response to variable soil fertility levels in greenhouse and field. This is a progress report. Six tables are presented.

Results of calibration tests to date are best summarized by listing present interpretations of soil test results for various crops. Interpretations of tests are given in the table.

Soil-Test Interpretation

(Pounds per acre)

Crop Group	Very low	Low	Medium	High	Very high
			Phosphorus		
Blueberries, cane fruit, soybeans......	0-5	5-10	10-20	20-30	30
Alfalfa, clover, and grass hay and/ or pastures, corn, small grains, apples, grapes, turf.................	0-5	5-10	10-20	20-40	40
Peaches................................	0-10	10-20	20-35	35-50	50
Asparagus, beans, beets, cucurbits, crucifers, peppers, white and sweet potatoes, strawberries, young fruit trees....................	0-10	10-20	20-40	40-60	60
Celery, eggplants, onions, peas, sweet corn, and leafy vegetables such as lettuce, spinach, etc........	0-15	15-30	30-60	60-90	90
			Potassium		
Corn, small grains, grass pasture and hay, all fruit except strawberries, soybeans, turf..............	0-40	40-80	80-120	120-160	160
Asparagus, beans, beets, cucurbits, crucifers, peppers, tomatoes.........	0-50	50-100	100-150	150-200	200
Celery, eggplants, onions, peas, sweet corn..........................	0-75	75-125	125-200	200-300	300
Alfalfa, clover pasture, and hay.......	0-100	100-200	200-300	300-400	400

N. J. Agr. Expt. Sta., New Brunswick, N. J.

Nelson, W. L., Reed, J. F., and Munson, R. D. LOOKING AHEAD IN SOIL TESTING. Agr. and Food Chem. 8(2): 101-104. 1960.

While soil testing is only one of many tools to assist the farmer in doing a precision job, it is an important link that demands top-flight programs. Thus we need to think ahead and consider what the agricultural producer might want in the future--say 10 years hence. We must keep in mind that he will have a high investment business operation and will be interested in maximum profits. He will want to eliminate as many limiting factors as possible. Through adequate soil testing one controllable factor, plant nutrient supply, will be taken care of. The prime objective is the most efficient and profitable use of lime and fertilizer by agricultural producers.

American Potash Inst. Inc., Washington, D. C.

Miller, J. R. RESEARCH IN MARYLAND ON CHEMICAL METHODS FOR DETERMINING AVAILABLE PHOSPHORUS AND POTASSIUM IN SOILS. Agr. and Food Chem. 8(2): 87-91. 1960.

There was often little difference between the correlation coefficients obtained for the various chemical methods used to determine phosphorus in the soils. However, when all the soils in the investigation (those treated with rock phosphate or superphosphate) were considered, a proposed method employing sulfuric acid and ammonium fluoride as an extractant apparently showed the closest relationship with crop response. When the soils receiving rock phosphate were not considered, the modified Truog method gave the highest correlation with crop response data of all soluble phosphorus methods studied. However, on rock phosphate--treated soils, the Truog and other methods employing acid extractants removed more phosphorus from the soils than was readily available to the plants as indicated by the yields.

In the pot culture experiment the soil series determined to a large extent the correlation between phosphorus extracted by the different methods and the yields of alfalfa. The quantities of 20% superphosphate required to establish similar levels of chemically available phosphorus in these soils varied in some cases by a ton or more.

The levels of extractable phosphorus in the soils for the different chemical methods at which phosphate applications often failed to increase the yields of alfalfa in the pot culture experiment were: 55 pounds per acre, modified Truog; 55, Bray and Kurtz No. 1; 55, North Carolina; 35, sodium bicarbonate; and 70, the proposed method.

The correlation coefficient for the relation between potassium extracted from a Monmouth soil by the North Carolina method and the yields of tobacco in a field experiment for a 6-year period was significant at the 1% level. In this same experiment the phosphorus extracted also showed a close relationship with tobacco yields.

The thermal method proposed by Kolterman and Truog showed some promise for determining the relative potassium-supplying power of soils.

U. Md., College Park, Md.

Anderson, M. S. HISTORY AND DEVELOPMENT OF SOIL TESTING. Agr. and Food Chem. 8(2): 84-87. 1960.

The history and development of soil testing are considered in three approximate periods: 1845 to 1906, 1906 to 1925, and 1925 to 1952. Phosphorus and potassium are emphasized, but other elements are considered. Data of the second period provide background information for interpretation of soil tests. Many new methods have been developed, some for universal application and others for specific problems.

SWCRD, ARS, USDA, Beltsville, Md.

Soil Physics

Fox, W. E., and Page-Hanify, D. S. A METHOD OF DETERMINING BULK DENSITY OF SOIL. Soil Sci. 88: 168-171. 1959.

Methods of determining bulk density are discussed and evaluated. The requirements of an accurate method of determination are stated, and the design and use of an apparatus suitable for use on a soil free of stones described. Results of a field test of the apparatus are given.

U. Queensland, Queensland, Australia.

Janse, A. R. P., and Bolt, G. H. THE DETERMINATION OF THE AIR-PERMEABILITY OF SOILS. Netherlands J. Agr. Sci. 8: 124-136. 1960.

An improved apparatus for the determination of the air-permeability of soils at constant pressure gradient is described. The merits of this apparatus are discussed. Some experimental results obtained with a sandy soil under different tillage conditions are given as an example of the application of this determination.

Agr. State U., Wageningen, The Netherlands.

Beaton, J. D. THE INFLUENCE OF BURNING ON THE SOIL IN THE TIMBER RANGE AREA OF LAC LE JEUNE, BRITISH COLUMBIA. Canad. J. Soil Sci. 39: 1-11. 1959.

Three-inch soil cores were taken in triplicate from areas that had been burned in 1943, 1945, and 1951, and from corresponding unburned areas present within each burned-over area.

Studies carried out on these cores taken from the 0 to 3-inch layer of soil revealed that, as a result of burning, there were decreases in total porosity and non-capillary porosity and an increase in capillary porosity. Field investigations showed that there was a decrease in the infiltration rate of burned soils and that there was an increase in soil temperature at a depth of 3 inches in burned soils.

U. British Columbia, Vancouver, British Columbia, Canada.

Soil Biology

Misterski, W., and Loginov, W. A STUDY OF SOME PHYSICOCHEMICAL PROPERTIES OF HUMIC ACIDS. Soviet Soil Sci. 2: 170-181. Feb. 1959.

Investigations of the coagulation of humic substances have discovered no clear boundaries between their individual fractions.

Natural humic acids must be considered as organic-mineral compounds. The mineral elements and the nature of their bonds with the humic acids affect the colloidal nature and the reactions of the humic acids in the soil.

Humic acids in the presence of calcium ions are capable of attaching themselves to phosphates. The amount of phosphate that may be attached is limited, and the process itself is extremely complicated because of the appearance of secondary reactions. There are two kinds of compounds of phosphates with humic acids; stable compounds, and non-stable compounds which originate at lower pH values and apparently are of the nature of salts.

A humic acid particle consists of an aromatic nucleus and peri-pheral parts capable of hydrolysis, and also of mineral elements. The principal substance in the peri-pheral parts, containing almost 10% of nitrogen, is amino acids. The peri-pheral parts have a strong effect on the colloidal nature of the humic acids.

Humic acids may be coagulated by ions of Ca, Fe, and Al. Under specific conditions, this coagulation is reversible. Phosphates greatly affect the peptization of the coagulate, sulfates have a smaller effect, and chlorides and nitrates peptize only the calcium humates.

Amer. Inst. Biol. Sci., 2000 P St. N. W., Washington 6, D. C.

Tyagny-Ryadno, M. G. BIOPHYSICAL AND CHEMICAL ANALYSIS OF SOIL AGGREGATES. Soviet Soil Sci. 12: 1378-1387. Dec. 1958.

Correct estimation of soil fertility requires biophysical and chemical analysis not only of average soil samples, but also of soil aggregates of various diameters.

The pH, Eh (Oxidation reductions potention) and rH_2 within the aggregates differ sharply from those of the usual soil mixtures, which often have more reducing and alkaline properties. The mesoaggregates have a higher oxidation-reduction potential and a more neutral reaction in the medium than do the microaggregates, and the potential within all the aggregates is higher than on their surfaces.

The oxidation-reduction potential and the pH of the aggregates are determined by the periods and stages of the soil forming process, by the aggregate diameters, and by their biophysical and chemical properties during the course of the annual cycle.

The total quantity of aerobic bacteria in the aggregates differs according to their diameters. In some soils these bacteria are predominantly in the macroaggregates, and in others in the mesoaggregates. Bacteriological analysis of the aggregates supplements the usual analysis of average soil samples and makes the results more accurate. Both the aggregate diameters and their actual content in the soil are important in this regard.

In some soils there are more bacteria on the surfaces of the aggregates than within them (meadow soil, sierozem); in others there are two or three times as many microbes within the aggregates as on their surfaces (ordinary chernozem, meadow-bog soil, crusty and fluffy solonchaks).

The nutrients for higher plants accumulate differently in different aggregate diameters. In the majority of the soils investigated, ammonia and P_2O_5 are concentrated mainly in the microaggregates, and nitrates in the mesoaggregates. The greatest contents of humus and nitrogen in all the soil groups are found in the mesoaggregates, the smallest in the microaggregates and the medium-quantity accumulations in the macroaggregates. One must therefore study not only average samples of the soil, but also the aggregates composing it.

Amer. Inst. Biol. Sci., 2000 P St. N.W., Washington 6, D.C.

Stevenson, F. J. CARBON-NITROGEN RELATIONSHIPS IN SOIL. Soil Sci. 88: 201-208. 1959.

The distribution of fixed ammonium in a number of soil profiles representative of several great soil groups is given. From 3.5 to 7.9 percent of the nitrogen of the surface soils examined was found to occur as fixed ammonium. The relative amount of the nitrogen as fixed ammonium increased with increasing depth in the soil profile. In one sample, over three-fourths of the nitrogen was fixed ammonium. The increase in the relative amount of the nitrogen as fixed ammonium with depth was due chiefly to the decrease in organic nitrogen with depth.

Narrowing of the carbon-nitrogen ratio with depth was found to be due to a combination of two factors: (1) An increase, with depth, in the relative amount of the soil nitrogen as fixed ammonium; and (2) the presence of a relatively higher amount of nitrogen-rich constituents in the organic matter of subsoil as compared to surface soil. Narrowing of the carbon-organic nitrogen ratio with depth was found to be due to non-proteinaceous constituents of the fulvic acid fraction of soil organic matter.

U. Ill., Agr. Expt. Sta., Urbana, Ill.

Allison, F. E., and Cover, R. G. RATES OF DECOMPOSITION OF SHORTLEAF PINE SAWDUST IN SOIL AT VARIOUS LEVELS OF NITROGEN AND LIME. Soil Sci. 89: 194-201. 1959.

Laboratory studies are reported in which the rate of decomposition of shortleaf-pine sawdust in soil was determined, using various kinds and rates of nitrogen in the presence and absence of lime. A convenient system for the determination of CO_2 evolution is described.

Under conditions of air saturation with moisture, wood particles that barely passed through a 6-mesh sieve decomposed about as rapidly as did smaller ones; similarly, particles left on the soil surface decomposed about as rapidly as when mixed with the soil.

During an incubation period of 72 days at 30°C., the release of CO_2 from unlimed sawdust without added nitrogen was 68 percent as great as with adequate nitrogen; in the presence of 0.4 percent $CaCO_2$ the corresponding value was 79 percent.

Nitrogen additions sufficient to make the nitrogen contents of the wood 0.75 to 1.0 percent were adequate for a maximum rate of decomposition in this low-nitrogen sandy loam. This value varies with the ability of the soil to supply nitrogen. Sawdust decomposition was favored more by the addition of nitrate-nitrogen than by ammonium salts, where the development of acidity was not controlled. A covariance analysis showed that the inferiority of ammonium was due chiefly to the higher acidity. Where neutrality was maintained by additions of lime, the two nitrogen sources were equally satisfactory.

During a period of 160 days, with adequate nitrogen supplied, 58 percent of the wood carbon was released as CO_2; the corresponding value for wheat straw was 64 percent.

SWCRD, ARS, USDA, Beltsville, Md.

Douglas, L. A., and Tedrow, J. C. F. ORGANIC MATTER DECOMPOSITION RATES IN ARCTIC SOILS. Soil Sci. 88: 305-312. 1959.

Rates of organic matter decomposition in arctic soils of northern Alaska were studied in the laboratory using the Warburg microrespirometer, and in the field using evolved-CO_2 techniques. It was found that temperature, moisture levels, and soil type all had important influences on rate of organic decomposition. At 7°C., the decomposition rate per gram of soil was highest for the half-bog soil; intermediate for the upland tundra and peaty, high-center polygon; and lowest in the arctic brown soil. Based on evolved-CO_2 studies in the field, it was estimated that there was a decomposition rate of approximately 1050 pounds of organic matter per acre per year in the 1- to 0-inch layer of the arctic brown soil, but, due to the discontinuous nature of the organic mat, the amount decomposed on an acre basis probably approximated half this value. The mineral horizon at the 0- to 4-inch depth showed a decomposition of approximately 300 pounds of organic matter per acre during 1957. The upland tundra soil had an estimated organic matter decomposition rate of 850 pounds per acre per year; the half-bog, 1700 pounds; and the high-center peaty polygon, 600 pounds.

N.J. Agr. Expt. Sta., Rutgers--The State U. N.J., New Brunswick, N.J.

EROSION CONTROL

Wind and Water Erosion

Chepil, W. S. WIND ERODIBILITY OF FARM FIELDS. J. Soil and Water Conserv. 14: 214-219. 1959.

The author indicates how width of field is interrelated with other major factors that influence erosion of soil by wind. He indicates too how the wind erodibility of any field or field strip may be determined for any soil, surface condition, and wind velocity and direction. Graphs and alignment charts are presented for convenient determination of field erodibility or of conditions required to reduce the field erodibility to any degree.

SWCRD, ARS, USDA, Manhattan, Kans.

Craig, D. G. CONTROL OF WIND EROSION IN THE GREAT PLAINS. J. Soil and Water Conserv. 14: 147-151. 1959.

The ten Great Plains States contain most of the semi-arid lands of the nation. Within this area is the Great Plains agricultural region which extends from the Eastern Slope of the Rockies to the 98th meridian to the east. The region is about 750 miles wide at its widest point across Montana and North Dakota, and extends from the Canadian border on the north to the Mexican border on the south. It contains 586,461 square miles or 20 percent of the land area of the nation. One-third of the people living in the 10 states or 3.7 percent of the population of the entire United States live in the area. The Great Plains encompasses the "Dust Bowl" which attracted national and international attention in the 1930's and again in the 1950's.

The climate of the Great Plains varies widely. Hot summers and cold winters are characteristic. The region is clearly distinguished from the humid areas to the east and the arid area to the west.

The effects of: (1) Stubble mulching; (2) windbreaks; (3) grass strips and grassed waterways; and (4) strip cropping and other practices are described.

The author makes the following conclusions: Wind erosion can be controlled if suitable combinations of practices are installed and maintained. Wind erosion will never be entirely eliminated from the Great Plains. Nevertheless, there are now conservation tools and practices available. Research on the problems and fundamentals of wind erosion and related aspects is moving forward at an increased tempo. More and more earnest farm and ranch cooperators are applying practices which they have learned are helping in subduing the effects of drouth and wind.

Southern Great Plains Agron., SCS, USDA, Fort Worth, Tex.

American Geophysical Union. EROSION AND SEDIMENTATION. Amer. Geophysical Union Trans. 41: 301-305. 1960.

A review of the recent literature on erosion and sedimentation is presented.

Committee on Erosion and Sedimentation, Baltimore, Md.

Smith, D. D., and Wischmeier, W. H. CURRENT CONCEPTS AND DEVELOPMENTS IN RAINFALL EROSION RESEARCH IN THE UNITED STATES. 5th Int'l. Cong. Agr. Engin. Trans., Brussels, Belgium. 1: 457-469. 1960.

Rainfall erosion research in the United States since its beginning about 1917 has depended largely upon fractional acre plots under natural rainfall conditions. Currently, the research is proceeding generally as follows: (1) Continued use of natural rainfall plots to establish normal annual rates of erosion under broad ranges in crop cover in general climatic and soil areas; (2) development of field plot simulators for studying and evaluating soil and water management and conservation practices; (3) development of fundamental principles through use of drop towers and special applicator units designed to reproduce the desired characteristics of natural rainfall, and soil pans that provide necessary tension, moisture, and overland flow conditions; and (4) summarization and analysis of all data collected under natural and simulated rainfall on field plots through use of modern electronic digital computers as required for the development of an universal soil loss equation.

A method has been developed for calculating rainfall energy from recording gage records. The interaction term, rainfall energy times 30-minute maximum intensity, was found to be more highly correlated with individual storm soil loss from fallow plots than amount and intensities in multiple regressions and was selected as a satisfactory numerical index of erosion potential of localized rainfall for use in derivation of rainfall erosion indices. Monthly and annual erosion indices based on twenty or more years of records fit the log-normal distribution pattern common to most hydrologic data. The principal utility of the indices will be for accurate evaluation of localized factors in the universal erosion equation from which tables or other guides are prepared for application of soil and water conservation measures to the land.

SWCRD, ARS, USDA, Beltsville, Md.

Barnett, A. P., Rogers, J. S., and Cobb, C., Jr. THUNDERSTORMS--PRINCIPAL CAUSE OF EROSION IN GEORGIA'S PIEDMONT. Ga. Agr. Res. 1(4): 8-9. 1960.

Excessive rate storms have been found to be the principal cause of erosion on agricultural lands of the Piedmont. These storms can best be described as thunderstorms or thunder showers. Although they usually occur during the warmer months, they may occur at any time. Thunderstorms concentrate the rainfall on the land in a short period of time. This results in high runoff and erosion. One-half inch of rain falling in half an hour is an excessive rate storm.

Based on 20-years data at Watkinsville, we can expect an average of eleven thunderstorms (excessive rate storms) each year--extremes have ranged from 7 to 16. These eleven storms contain one-fourth of the rainfall, result in 56 percent of the runoff, and cause 86 percent of the erosion during an average year from continuous cotton on terraced Class IIIe land. These eleven storms last a total of only 28 hours, or slightly over 1 day out of 365.

Nine thunderstorms occur during the spring and summer period--the time that clean tilled crops usually occupy the land. With our greatest erosion hazard occurring at the same time that our land is usually least protected, it is not surprising that erosion is a serious and costly problem in the Piedmont.

SWCRD, ARS, USDA and Ga. Agr. Expt. Sta., Athens, Ga.

Pierre, J. J., and Wischmeier, W. H. THE SLOPE-PRACTICE METHOD SHOWS FARMERS HOW TO CONTROL SOIL LOSSES. County Agent and Vo-Ag Teacher. 16(4): 28-29, 32. 1960.

Can erosion be controlled with a 4-year rotation of corn, soybeans, wheat and 1-year of meadow on moderately rolling farm soils?

Factors to consider in answering this question are the same as those which were considered in developing the slope-practice method. On each field, the farmer is faced with a given combination of basic factors which influence the rate of erosion. These include climate, soil characteristics, percent and length of slope, prior erosion, and cropping history. He has a choice of various combinations of cropping, management, and conservation practices which he may apply on the given set of conditions. With the slope-practice equation it is possible to estimate the average annual soil loss per acre for each alternative combination of conservation practices and cropping systems considered for the field.

In order to make fast and reliable soil-loss estimates right in the field, a "conservation slide rule" has been developed from the information in the base slope-practice tables. In the hands of a trained technician, who knows the agriculture and the soils of the area in which he is working, the slide rule is an effective tool. It serves as a guide for selecting combinations of crops and practices that may be used to control water erosion.

SCS, USDA, Urbana, Ill.

Grant, W. J., and Struchtemeyer, R. A. INFLUENCE OF THE COARSE FRACTION IN TWO MAIN POTATO SOILS ON INFILTRATION, RUNOFF AND EROSION. Soil Sci. Soc. Amer. Proc. 23: 391-394. 1959.

The influence of the coarse material in Caribou and Thorndike soils on infiltration, runoff, and erosion was studied with the use of a laboratory infiltrometer which applied water at 2.5 inches per hour but with energy of impact appreciably less than that in natural rain of the same intensity. Various sized coarse particles were removed from both soils to determine the function of the coarse fraction. There was a significant decrease in the rate of infiltration and likewise an increase in runoff as the particles $>$12.7 mm. were removed from both soils. A further decrease in infiltration resulted when all material $>$4.76 mm. was removed; however, the fraction between 4.76 mm. and 2.38 mm. did not have a significant effect on infiltration and runoff.

The amount of soil in the runoff from the Caribou sample was found to be nearly proportional to the runoff. It also increased with runoff as the coarse fractions were removed from the Thorndike soil, but there was not a significant increase for the second and third trials on the same sample even though the runoff increased. Some of the practical implications of the coarse fraction are discussed in relation to land use and the possible removal of coarse material for increased mechanization of farming operations.

SWCRD, ARS, USDA, Orono, Maine.

Strip Cropping

Chepil, W. S. HOW TO DETERMINE REQUIRED WIDTH OF FIELD STRIPS TO CONTROL WIND EROSION. J. Soil and Water Conserv. 15: 72-75. 1960.

Earlier studies have indicated that the rate of soil movement begins with zero on the windward side of fields or field strips and increases with distance downwind. The more susceptible the soil is to wind erosion, the greater is the rate of increase in soil flow with distance downwind and the narrower the strips have to be to keep erosion from exceeding a tolerable minimum.

To determine how wide field strips must be, it is necessary first to estimate the susceptibility of the soil to erosion by wind. Best indices of wind erodibility are the state and stability of dry soil structure. The state of structure is the percentage of nonerodible dry aggregates (clods) greater than 0.84 mm. in diameter determined by dry sieving. This percentage is known as index I. The stability of structure determines how rapidly the soil clods and surface crust will disintegrate from the bombardment of bouncing soil grains after erosion has started. An index of stability of structure is soil texture. It is designated as factor F.

A method is presented that determines the width of field strips needed under various conditions.

SWCRD, ARS, USDA, Manhattan, Kans.

Latham, B. M. NO TERRACES--JUST CONTOUR STRIPS. Soil Conserv. 25: 157. 1960.

Change--that's what you will find taking place continually in the soil and water conservation program. And that's what you will find on the Charles McIlwain farm in Abbeville County, South Carolina, where there isn't a single terrace--they used to be there, but they have been eliminated. Contour strip rotations, with strips 72 feet wide, are used instead of terraces. Every other strip is in small grain. This system gives adequate rotation to protect the Class II land and at the same time, if properly laid off, will give all long rows.

Mr. McIwain says, "If you are not going to follow a good strip rotation that will protect the land, you had better stick to terraces." McIlwain has been following this system for 3 years and he likes it fine.

With the parallel strips, McIlwain uses every natural depression for a grass waterway. The meadows used for drainage are small and the cultivating equipment can cross them without difficulty. He just elevates the plow blade when he comes to one, crosses the meadow and continues the cultivation of the crops.

"This system of contour strip rotations without terraces is a farmer's dream," says McIlwain. "No terraces to cross, no terraces to maintain, and all long rows."

SCS, USDA, Anderson, S. C.

Critical Areas

Atkins, M. D., and Coyle, J. J. GRASS WATERWAYS IN SOIL CONSERVATION. U.S. Dept. Agr. L. 477, 8 pp. 1960.

To establish and maintain an effective grass waterway: (1) Locate waterway in a natural drainageway if possible; (2) clear trees or brush from the site and shape to proper size; (3) prepare a good, firm seedbed and use a crop residue or a mulch to protect the waterway and grass seedlings during establishment; (4) select a grass or simple grass mixture that best fits the conditions of the waterway; (5) use good quality seed; (6) use grass origins and strains known to be adapted; (7) plant at the best date for the particular grass; (8) use planting equipment and methods that give uniform distribution and proper placement of seed; (9) fertilize according to the needs of the grass and your soil as shown by soil tests; (10) overseed or repair bare spots with sod chunks or mulch as necessary; (11) avoid using the waterway as a road or damaging the sod with tillage implements; (12) use the waterway moderately for grazing or hay; (13) mow when grass can make good regrowth and restore food reserves in the roots; (14) inspect frequently, especially after each heavy rain and repair any damages at once; and (15) keep livestock and equipment out of the waterway when it is wet and soft unless it is naturally a seepy area.

SCS, USDA, Inform. Div., Washington 25, D.C.

Porter, H. L., Jr. ESTABLISHING GRASS WATERWAYS. J. Soil and Water Conserv. 14: 211-213. 1959.

The sites on which plantings were established (1955-57) represent the most severe outlet problems encountered in southern New York and northern Pennsylvania. Observations indicate that the quality of outlet vegetation can be improved by careful attention to: (1) Approved design and construction; (2) exclusion of as much of the watershed as possible during the establishment period; (3) adequate liming and heavy fertilization including manure; (4) good firm seedbed, and recommended seeding practices; (5) mulching and tying mulch in place if necessary; (6) timely seeding; (7) the use of adapted mixtures; and (8) good management to maintain fertility and avoid damage by traffic and livestock.

Plant Material Tech., SCS, USDA, Big Flats, N. Y.

Holmberg, G. VEGETATING CRITICAL AREAS. J. Soil and Water Conserv. 14: 165-168. 1959.

Erosion control work is going to grass in Iowa's Little Sioux watershed--or more accurately to grass and legumes. The new grass program, teamed with terracing, mulch growing, and increased use of fertilizer, is helping farmers cut costs. With runoff reduced, only about half as many structures are needed as formerly.

The Little Sioux originates in Nobles and Jackson Counties in Minnesota and empties into the Missouri River at a point about midway between Sioux City and Omaha. Loess soils cover the lower two-thirds of this 4,500 square mile watershed. In the upper third the soils are of glacial origin. Here the topography is level to gently rolling with much of the area having drainage problems.

The most serious erosion problem is the erosive upland soils of the lower third of the watershed. In this hilly area the coarse loess ranges from 25 to more than 50 feet deep. Gullies frequently develop to depths of 50 feet or more. Slopes usually range from 5 to 25 percent but some are steeper than 50 percent. Without soil and water conservation measures annual soil losses on row crop areas are often 80 to 100 tons per acre. Annual rainfall in the watershed is from 25 to 28 inches.

The establishment and maintenance of vegetative cover on dams, basin terraces, borrow areas, waterways, and floodways, involves many different techniques. The methods must be easily applied, effective, and economical. These techniques are: (1) Growing mulch of small grain with a permanent grass-legume mixture; (2) fertilizing; (3) temporary diversions on critical areas; (4) level terraces on raw subsoil borrow areas located on hillsides before attempting to establish vegetation; and (5) use of reed canary grass in wet waterways and around ponds for wave action control.

Mangt. Agron., SCS, USDA, Sioux City, Iowa.

Brown, J. H., and Tryon, E. H. ESTABLISHMENT OF SEEDED BLACK LOCUST ON SPOIL BANKS. W. Va. Agr. Expt. Sta. B. 440, 34 pp. 1960.

Strip mining of coal has directly affected approximately 70,000 acres of land in West Virginia. Since 1945, law has required that stripped areas be revegetated. In West Virginia, direct seeding has been the most common method of artifically revegetating spoil banks.

A survey was made of randomly-selected spoil banks throughout the State on which black locust had been direct seeded. Investigation of the vegetation, including direct-seeded black locust and natural vegetation, and site factors on these areas indicated the following:

1. An evaluation of the effectiveness of direct seeding of black locust in providing cover on spoil bank areas indicated that: (1) On 20 percent of the area, adequate cover had been provided; (2) on nearly 50 percent of the area, the seedings had been failures and adequate cover had not been provided; and (3) on the remaining 30 percent of the area, seedings ranged between success and failure.
2. Direct seeding of black locust resulted in an average abundance of 464 seedlings per acre and an average distribution or percent stocking of 40.4 percent on the spoil areas in West Virginia. On individual spoils, abundance varied from 0 to 2,000 seedlings per acre. Distribution of seedlings ranged from 0 to 83 percent.
3. Thirty-seven different woody species were found to be seeding in naturally on spoil bank areas throughout the State. Approximately 78 percent of the natural reproduction consisted of species which have little or no commercial value. The average abundance of natural seedlings was 684 trees per acre, and the average

distribution was 49.7 percent. Because of slower growth, narrower crowns, and less litter produced, most of these natural species will not provide as good cover and stabilization as black locust.

4. The study of vegetation on 289 sample plots showed a definite correlation between soil pH and vegetation. Below pH 4.0 little or no vegetation occurred on the area. At pH 4.0 and above, woody seedlings, mainly hardwoods, increased in direct relationship to the increase in pH. This increase was probably due to a preference for the higher pH values by most of the woody species becoming established on the spoils. Herbaceous vegetation, on the other hand, was fairly constant on areas having pH 4.0 and above.
5. November through March seemed to be the best period for directing seeding of black locust.
6. Low precipitation periods, considered to be either droughts or near droughts, were found to reduce the number of surviving black locust seedlings.
7. The study of woody seedlings established on 840 milacre plots having slopes of 30 to 95 percent generally showed that as percent slope increased, the number of established seedlings on the area decreased.

W. Va. U., Agr. Expt. Sta., Morgantown, W. Va.

Viets, F. G., Jr., and Muckel, D. C. RECLAMATION OF TIDAL SOILS. International Comn. Irrig. and Drain. 4th Cong., Madrid, Spain. Quest. 11: 1-16. 1960.

Reclamation of sediments from sea or brackish water involves a very careful evaluation of the engineering factors involved in water control and drainage. An understanding of the problems that may arise in the removal of salts, exchangeable sodium and potential acidity so that the soil can be productive, is needed. The actual draining of tidal marshes does not generally entail any considerable technical difficulties.

Levees are usually required to prevent inundation during high tides. Main and lateral drain ditches are required for the removal of excess surface and subsoil water, and outlets, either gravity or pumping plants, are required for the disposal of excess water. Design factors must be based on site conditions such as amount and distribution of precipitation, surface runoff, topography, soil characteristics, tidal fluctuations, and degree of protection warranted.

Water control is important in the design of the drain system. Drainage alone does not guarantee maximum crop yields. The system should be designed and operated whereby the water-table depth can be maintained at proper levels for the particular soil and crop to be grown, taking into consideration the changes which occur in the soil after reclamation or drainage.

The chemical and fertility problems involved in reclamation after drainage and water control have been established are: removal of salts, replacement of exchangeable sodium, correction of acidity, and adequate supplies of plant nutrients. Removal of salts and boron by leaching and the displacement of exchangeable sodium by leaching, using gypsum when needed, do not pose any unusual or insurmountable problems. Supplying adequate plant nutrients when one or more are deficient is also fairly easy using modern diagnostic techniques and available fertilizer materials.

Careful evaluation of the problem of excess sulfides which may lead to extreme acidity when the soil becomes acerated, must be made. Most of the reclamation failures have been due to extreme acidity and the formation of "cat clays" resulting from excess oxidizable sulfides. Such soils in some instances are used for rice or for pasture, but with only a limited degree of success.

SWCRD, ARS, USDA, Fort Collins, Colo.

SOIL MANAGEMENT

Cropping Practices

Collier, J. W. INFLUENCE OF CROPPING SYSTEM-TREATMENT COMBINATIONS AND CLIMATIC FACTORS ON CORN YIELDS IN THE BLACKLAND AREA OF TEXAS. Agron. J. 51: 587-590. 1959.

Without irrigation, corn after sweetclover produced higher yields than continuous corn every year but one. Responses to nitrogen were small and inconsistent. Irrigation increased yields but responses to nitrogen occurred only in the continuous corn system. Soil nitrates and leaf nitrogen were generally higher from plots following sweetclover. Maximum yields were negatively correlated with the mean maximum temperatures during the 3-week period after silking.

Summary of corn yields by years, cropping systems, treatments, and plant populations from 1952 through 1957.

Irrigation	Lb.N per acre	Plants per acre	Corn yield in bushels per acre						
			1952	1953	1954	1955	1956	1957	Average
						Continuous corn			
Not Irr.	0	6,000	50.4	32.6	29.4	57.2	24.9	37.7	38.7
		12,000	54.3	31.5	28.6	62.5	18.9	38.3	39.0
		18,000	--	--	--	--	--	34.2	--
	90	6,000	54.8	31.5	36.4	60.0	20.3	44.3	41.2
		12,000	64.5	28.5	40.3	63.2	22.8	55.3	45.8
		18,000	--	--	--	--	--	44.4	--
Irrigated	0	6,000	57.9	47.3	34.6	51.8	30.0	36.4	43.0
		12,000	58.0	53.7	27.5	54.2	32.1	42.1	46.3
		18,000	--	--	--	56.4	--	46.0	--
	90	6,000	79.2	48.3	60.9	72.4	50.4	56.0	61.2
		12,000	86.3	63.8	86.3	94.7	61.4	63.2	76.0
		18,000	--	--	--	117.8	--	63.4	--
						Corn after sweetclover			
Not Irr.	0	6,000	63.0	42.6	44.0	48.5	39.3	61.2	49.8
		12,000	71.9	34.7	48.4	53.4	37.6	76.0	53.7
		18,000	--	--	--	--	--	74.8	--
	90	6,000	58.4	31.0	41.0	48.3	35.5	61.8	46.0
		12,000	66.1	29.6	43.7	49.2	37.5	77.0	50.5
		18,000	--	--	--	--	--	80.2	--
Irrigated	0	6,000	77.0	61.8	67.1	78.6	55.1	71.3	68.5
		12,000	93.4	84.9	88.8	106.1	73.3	93.8	90.0
		18,000	--	--	--	125.8	--	97.2	--
	90	6,000	73.4	67.5	64.3	78.5	51.2	70.2	67.5
		12,000	91.8	81.6	84.8	105.0	64.2	96.0	87.2
		18,000	--	--	--	122.2	--	107.3	--

SWCRD, ARS, USDA and Tex. Agr. Expt. Sta., Temple, Tex.

Stringfield, G. H., and Haynes, J. L. WIDE CORN-ROW SPACES AND WHEAT INTERSEEDINGS. Agron. J. 51: 390-391. 1959.

Wheat was (1) interseeded near the Hessian fly-safe date in unharvested full-season corn that had been planted in widely spaced rows, and (2) seeded conventionally after discing stalk ground following mechanical harvest of early corn. The interseeded wheat gave the larger average yields by 2 bushels per acre on moderately well drained Canfield sil and by 13 bushels on poorly drained lacustrine soil. This latter difference would more than compensate for the reduced corn yields incident to wide row spaces.

Full-season corn in rows spaced 72-inches apart at its optimum stand of about 12,000 plants per acre yielded 10 to 15 bushels per acre less than early corn in rows spaced 42 inches apart at its optimum stand of about 16,000 plants per acre.

On slow-draining soils of the eastern Corn Belt where heaving and winter-killing are normal wheat hazards, the use of wide corn-row spaces planted to a full-season corn hybrid interseeded with wheat at the Hessian fly-safe date may be an attractive alternative where the corn-wheat sequence is advantageous.

CRD, ARS, USDA and Ohio Agr. Expt. Sta., Wooster, Ohio.

Haynes, J. L., Stringfield, G. H., and Johnson, W. H. EFFECT OF CORN PLANTING PATTERN ON YIELD, ROOT EXTENSION, AND INTERSEEDED COVER CROPS. Agron J. 51: 454-456. 1959.

Among 8 corn-planting patterns interplanted with cover crops, more improvement in stand establishment of cover crops per bushel reduction in corn yield occurred in corn drilled in 63-inch rows than in hilled patterns of various dimensions.

Ohio Agr. Expt. Sta., Wooster, Ohio.

Toogood, J. A., and Lynch, D. L. EFFECT OF CROPPING SYSTEMS AND FERTILIZERS ON MEAN WEIGHT-DIAMETER OF AGGREGATES OF BRETON PLOT SOILS. Canad. J. Soil Sci. 39: 151-156. 1959.

Aggregate analyses of soil samples from soil fertility plots at Breton using a wet sieving technique revealed marked differences resulting from cropping practices but few, if any, due to fertilizers. The mean weight-diameter of soils from plots in a 5-year rotation of grains and legumes was almost double the diameter of soils from plots in a wheat-fallow sequence. With respect to fertilizers, however, mean weight-diameter of soils from high yielding plots in either cropping system were in general similar to those on low-yielding plots of the system in question. Incidentally polysaccharide content of the soil showed a definite relationship to mean weight-diameter of the soils.

U. Alberta, Edmonton, Alberta, Canada.

Kommedahl, T., and Wilcoxson, R. D. DO CROP ROTATIONS REDUCE PLANT DISEASE? Crops and Soils 12(2): 10-11. 1959.

For many years farmers have used crop rotations to help control plant diseases. Good rotations also reduce soil erosion losses, diminish insect attacks, and maintain soil productivity.

Recent trends in certain crops have, however, resulted in continuous cropping--and less crop rotation--a movement that may greatly complicate the plant-disease problem.

To study the effects that cereal crops might have on the incidence of disease in succeeding crops, a crop-sequence experiment was established 10 years ago at the Rosemount Experiment Station of the University of Minnesota.

Corn, oats, wheat, flax, and soybeans followed each other in various planned rotations. They were managed (plowed, planted, cultivated, harvested, etc.) the same as typical farm fields. Data on disease occurrence in both crops and soils were kept.

A summary of findings are: (1) Root-rot incidence was highest in corn and wheat when these crops followed corn or wheat in the rotation, but lower when they followed oats, flax, or soybeans; (2) during seasons favoring root-rot occurence, this disease increased in oat fields that were in corn or wheat the previous year; (3) in all cases, root rot was more prevalent in stands of susceptible varieties; (4) when cornstalk breakage occurred, it was more damaging on corn that followed corn or wheat; (5) smut--unlike root rot and stalk breakage--was more severe in corn stands following oats, flax, or soybeans; (6) more pathogenic fungi were found in the root-zone soil of susceptible varieties than in that of resistant varieties of corn, oats, and wheat soils; and (7) adding oat stubble or straw to the soil increased the number of desirable microorganisms and reduced the number of root-rotting microorganisms in the root zone.

U. Minn., St. Paul, Minn.

Yonce, R. P., and Malmgren, R. C. FARMING LAVA BEDS ON THE ISLAND OF HAWAII. Soil Conserv. 25: 86-88. 1959.

The Island of Hawaii is starting to make more use of its rocky land as a result of a continual desire of people to become landowners. Experience locally with such crops as Macadamia nut, coffee, and certain truck crops indicates the development of these lands for these crops is economically sound.

In the Puna Soil Conservation District, on the Island of Hawaii, one-third of the farming is done on old lava beds.

Two major types of rocks occur as a result of lava flows: Aa, which is like cinders or clinkers and has a rough and broken surface; and Pahoehoe, which is massive bedrock with a relatively smooth surface. The type being used most successfully is the Aa. It occurs at depths up to 20 feet.

There are two major obstacles involved in development of such land for production: the cost of the land and the clearing. Much of this land when it is available, sells for $150 to $200 per acre. This does not include a clearing and rolling operation, which costs about $150 an acre.

Heavy fertilization is necessary to grow profitable crops. Takao Niiya, manager of Farmers, Ltd., applies about 3,000 pounds of 10-10-10 fertilizer per acre annually on the papaya. This is applied at the rate of nearly 400 pounds per acre eight times a year.

The problems of mulching, crop-residue utilization, and windbreaks are serious. One very important step is to increase, or at least maintain, the organic matter between the rocks for more efficient response to fertilizer. Windbreaks are used principally for plant protection as coffee, papaya, and the Macadamia nut can tolerate very little wind.

While this area receives 90 inches annual rainfall, occasionally the distribution is such that small, newly started plants may suffer from a lack of water.

SCS, USDA, Hilo, Hawaii.

Yance, R. P. YOU CAN FARM FRESH LAVA. Better Crops 44(2): 32-33. 1960.

Hawaiians have been turning out crops on Aa lava clinkers, and Pahoehoe solid rock long before Captain James Cook landed on their shores in 1778. On the island of Hawaii one third of the farming is done on old lava beds.

Normally it takes several hundred years before organic matter forms and erosion breaks down Kilanea and Mauna Loa lava beds enough to farm.

Territorial senator, Richard Lyman, agriculturist and a director of the Puna SCS District, believes his lava test planting show man can get the jump on Nature by putting fresh lava in production soon after it cools. He successfully started nursery planting in a small lava patch a year after the last eruption. He used a spike or rooster to loosen Aa, bulldozed to flatten and crush the soft lumpy clinkers, then rolled the patch to pulverize and smooth it down. A foot square, foot deep hole is made. In planting Pahoehoe--a smooth, solid lava--its usually necessary to set holes with a drill.

Heavy fertilizations of a 10-10-10 fertilizer four to six times a year is necessary to feed plants and offset leaching from the 80-100 inch annual rainfall.

SCS, USDA, Hilo. Hawaii.

Shear, G. M., and Miller, L. I. INFLUENCES OF PLANT SPACING OF THE JUMBO RUNNER PEANUT ON FRUIT DEVELOPMENT, YIELD, AND BORDER EFFECT. Agron. J. 52: 125-127. 1960.

The effect of different close spacings on fruit development of the Jumbo Runner peanut was studied on small plots in which plants were equal distances from each other, in a checkerboard design.

With a 6- by 6-inch spacing the rate of fruit development was retarded, so that yields continued to increase after the fruit from plants grown at wider spacings had reached a maximum.

Although per plant yields decreased as the space between plants decreased, the per acre yields increased. With a 6- by 6-inch spacing, per acre yields of three tons or more of fruit were obtained. This is more than double the average yield obtained from standard spaced plants of this variety.

Va. Agr. Expt. Sta., Va. Polytech. Inst., Blacksburg, Va.

Williams, M. C., Slife, F. W., and Hanson, J. B. ABSORPTION AND TRANSLOCATION OF 2, 4-D IN SEVERAL ANNUAL BROADLEAVED WEEDS. Weeds 8(2): 244-255. 1960.

The outstanding success of 2, 4-D as a selective herbicide stems from the great susceptibility of many broadleaved (dicotyledonous) weeds to the compound. Applications of 2, 4-D which will eliminate many dicots will leave most grass crops relatively unaffected. Several suggestions that have been made for the differences in susceptibility between grasses and broadleaved weeds, including differences in foliar absorption, restricted translocation of the compound in grasses, and differences in detoxification of the 2, 4-D molecule.

Not all broadleaved weeds are equally susceptible to 2, 4-D, however. Some, such as bur cucumber (Sicyos angulatus) and jimson weed (Datura stramonium) are quite resistant and generally survive moderate 2, 4-D applications. No experimental inquiries appear to have been made into the nature of the resistance of these dicot weeds to 2, 4-D sprays. Presumably they might fail to absorb or translocate lethal amounts of herbicide; again, there may exist some internal cytoplasmic resistance, such as metabolic breakdown of the 2. 4-D or a reduced affinity of the molecule for the cytoplasmic sites of action. The experiments described here were conducted to evaluate the nature of 2, 4-D resistance in selected broadleaved weeds.

The author concludes: (1) Weed species which were resistant or sensitive to 2, 4-D when application was made through the foliage tended to react in a similar manner when the herbicide was absorbed through the roots. (2) Leaf disks and stem sections of jimson weed and bur cucumber absorbed considerably more 2, 4-D when placed in a 2 p. p. m. solution of methyl-labeled 2, 4-D than did cocklebur. Absorption in cocklebur ceased after a relatively small quantity of the growth-regulator had been absorbed. (3) Plants of jimson weed and bur cucumber absorbed and translocated greater quantities of 2, 4-D during a 24 hour period than cocklebur. (4) Evolution of $C^{14}O_2$ from 2, 4-D side-chain catabolism did not differ significantly among species. The amount recovered was extremely low in comparison with total 2, 4-D absorbed. (5) Transmission of 2, 4-D to a treated branch of cocklebur was negligible if that branch had several mature leaves. 2, 4-D seemed confined to the conductive tissues directly connecting the stem and treated branch. And, (6) tomatoes, while ruined commercially at relatively low 2, 4-D concentrations, were not easily killed upon reaching a height of 10-12 inches. Their resistance to kill at this stage compared to jimson weed in the 5-6 leaf stage.

CRD, ARS, USDA, Utah State U., Logan, Utah.

Hull, H. M. A TABULAR SUMMARY OF RESEARCH DEALING WITH TRANSLOCATION OF FOLIAR-APPLIED HERBICIDES AND SELECTED GROWTH REGULATORS. Weeds 8(2): 214-231. 1960.

A table briefly summarizes research findings involving the translocation of organic herbicides and certain selected growth regulators in higher plants. Information in the table is based on techniques which primarily utilize foliar application and for the most part does not include application via root system, injection, or bark application. As a consequence, most substances listed may be assumed to be transported predominantly in the phloem, but in numerous cases the compounds also move into the xylem.

CRD, ARS, USDA., Box 5735, Tuscon, Ariz.

MacPhee, A. W., Chisholm, D., and MacEachern, C. R. THE PERSISTENCE OF CERTAIN PESTICIDES IN THE SOIL AND THEIR EFFECT ON CROP YIELDS. Canad. J. Soil Sci. 40: 59-62. 1960.

From 1954 to 1958 at Kentville, Nova Scotia, the persistence and residual effects of certain pesticides, added to the soil annually from 1949 to 1953 inclusive, were investigated. Stability of pesticides in the soil rated in descending order of persistency was as follows: arsenic, DDT, BHC, chlordane. Arsenic, DDT, and sulphur caused decreases in the yields of some crops. Evidence indicated that DDT, BHC, and parathion were translocated to root crops. Increased concentrations of arsenic in the soil resulted in increased accumulations of the element in plants.

The use of lime in the soil did not ameliorate the toxic conditions resulting from the arsenic and DDT treatments, but did correct the effects of sulphur applications.

Canada Dept. Agr., Kentville, Nova Scotia, Canada.

Wiese, A. F., and Rea, H. E. BINDWEED (CONVOLVULUS ARVENSIS L.) CONTROL AND SEEDLING EMERGENCE AS AFFECTED BY TILLAGE, 2, 4-D, AND COMPETITIVE CROPS. Agron. J. 51: 672-675. 1959.

Bindweed on noncropped areas was controlled in 5 years with 2 annual applications of 2,4-D or by sweep tillage at 10 and 15 days after weed emergence. On winter wheat land bindweed was controlled with several combinations of sweep tillage and 2,4-D applications. Emergence of bindweed seedlings from the soil was reduced when applications of 2,4-D was used exclusively for bindweed control.

SWCRD, ARS, USDA and Tex. Agr. Expt. Sta., Bushland, Tex.

Ameen, O. A., Day, A. D., and Hamilton, K. C. EFFECT OF 1,2,4,5-TETRACHLOROBENZENE ON THE GERMINATION AND SEEDLING VIGOR OF BARLEY, OATS, AND WHEAT. Agron. J. 52: 87-89. 1960.

Four experiments were conducted in the greenhouse in 1958 at the University of Arizona to determine the residual effects of 1,2,4,5-tetrachlorobenzene (TCB) on the germination and seedling vigor of barley, oats, and wheat planted at different intervals after soil treatment in four different soil texture (sand, sandy loam, clay loam, and clay) for control of wild oats, (Avena fatua L.).

Soil applications of TCB decreased the germination percentage and seedling vigor of barley, oats, and wheat in all four soil types. The detrimental effects of TCB were most serious in sandy soil. As the soil type changed from sand, to sandy loam and clay loam, to clay, the damage produced by TCB decreased. With each increase in time interval between soil treatment and planting, there was a general increase in the germination and seedling vigor of small grains. Injury to small grains did not occur when planting was 125 days after soil treatment with up to 135 pounds of TCB per acre.

J. Article 529, Ariz. Agr. Expt. Sta., U. Tucson, Tucson, Ariz.

Brown, A. L., Jurinak, J. J., and Martin, P. E. PLANT GROWTH AS AFFECTED BY ETHYLENE DIBROMIDE FUMIGATION OF SOILS AT TWO MOISTURE LEVELS. Soil Sci. Soc. Amer. Proc. 23: 311-313. 1959.

The ever increasing use of soil fumigants as an integral part of soil management practice has accentuated the need for additional information concerning the factors affecting fumigant retention in soils.

Ethylene dibromide (EDB) was injected into Yolo l, Yolo c, and Staten peaty-muck at two moisture levels (air-dry and field capacity) at rates of 0, 0.01, 0.02, 0.05, 0.1, 0.5, 1.0, and 5.0 ml. per crock. The soils were allowed to stand for 2 weeks before transplanting tomato seedlings into them. The moisture level was then maintained adequate for growth.

The phytotoxicity of EDB was particularly marked in the air-dried soils, indicating greater retention of the fumigant vapor in the dry system as compared to the soils maintained at field capacity. The total Br taken up by the plants was generally greater from the moist soils than from the air-dry soils although the concentration in the plants was in reverse order. The concentration of Br in the plant increased with increasing rates of EDB. Analyses of the soils from water-soluble inorganic Br indicated there was more soluble Br in the soils maintained at field capacity than in those kept air-dry.

U. Calif., Davis, Calif.

Stelmach, Z. BROMINE RETENTION IN SOME SOILS AND UPTAKE OF BROMINE BY PLANTS AFTER SOIL FUMIGATION. Soil Sci. 88: 61-66. 1959.

Partial soil sterilization, primarily with volatile compounds and to a lesser extent with water-soluble salts, is a method that has been used to control nematodes and some soil-borne pathogens. Since nematodes have been controlled by certain bromine (Br) carriers, the investigation reported sought to determine: (1) The amount of Br retained by different soils; (2) the amount of Br taken up by plants at different growth stages; (3) the amount of Br present in different parts of plants; and (4) the yield of plants as affected by various Br carriers.

Ethylene dibromide, methyl bromide, and sodium bromide were used to determine the effect of Br on the Br content of plants and soils. Field experiments were located on Hillsdale sl, Brady l, and Houghton muck. Sodium bromide was applied in the greenhouse on Brookston cl, Oshtemo ls, and Houghton muck. Cabbage, snap beans, and table beets were grown on the treated soils and the effects of the treatments observed. Both crops and soils were sampled and analyzed at intervals during the growing season.

The beans and cabbage plants showed highest content of bromine at the initial sampling date. Beets growing in sodium-bromide-treated pots in the greenhouse contained as high as 978 p.p.m. Br and outyielded those not receiving Br. However, lower yields of beets were obtained in the field where the Br content of the roots was 975 p.p.m. Sodium bromide and methyl bromide lowered the yield of cabbage and beans in 1953. This did not occur with beans and beets in 1954 where methyl bromide was used. Damping-off disease apparently caused diminished yields of beets grown of Houghton muck where ethylene dibromide was applied.

The native Br content was similar in Oshtemo and Brookston soils but was low in Houghton muck.

In bean plants grown on untreated soil the highest Br content was in stems, next in roots, and lowest in leaves. In bean plants from Br-treated soil the order was: roots > leaves > stems.

Mich. State U., East Lansing, Mich.

Crop Residue Management

Chaffin, W. STUBBLE MULCHING. Okla. State U. Ext. Serv. C. E-706, 15 pp. 1960.

The system of managing plant residues on a year-round basis in which harvesting, tilling, planting, and cultivating operations are performed with a view of keeping protective amounts of vegetative material on the surface of the soil is known as "Stubble Mulching."

This illustrated booklet summarizes research data on stubble mulch tillage.

Coop. Ext. Work in Agr. and Home Econ., Okla. State U., Stillwater, Okla.

Duley, F. L. YIELDS IN DIFFERENT CROPPING SYSTEMS AND FERTILIZER TESTS UNDER STUBBLE MULCHING AND PLOWING IN EASTERN NEBRASKA. Nebr. Agr. Expt. Sta. Res. B. 190, 53 pp. 1960.

Research on the use of crop residue for protecting soil against excessive runoff and erosion was begun at the Nebraska Agricultural Experiment Station at Lincoln in the spring of 1938. The experiments were conducted chiefly on Sharpsburg sicl, rolling phase. This is a dark-colored, friable soil derived from Peorian loess. The climatic conditions varied widely during the period of these tests (1938-57), but the average was near normal. Some of the first work started on this project was concerned with the effect of crop residue maintained at the soil surface on the accumulation and storage of water in the soil profile. Storage of water during a summer fallow was increased 0.69 to 4.59 inches over plowed fallow, depending on the amount of residue present. Measurements were made on the effect of residue of different types on the amount of runoff and erosion. In a 3-year grain rotation, plowed land lost 2.6 times as much runoff and 4.8 times as much soil by erosion as did stubble-mulched land.

Highest corn yields were obtained from rotations containing two years of sweetclover. Corn rotations were compared during eight years when four of the more important rotations were represented. These results show that the three dry years, 1954-56, gave the greatest advantage for subtillage and the poorest results for legumes of the entire period. During these eight years, the mean increase for legumes was 7.3 bushels per acre, and the difference between subtillage and plowing was not significant. In the corn-oats-wheat rotation, plowing one year in three did not show any advantage over subtilling each year.

In one experiment five different legumes were grown (1950-55) with oats one year and then the residue and fall growth returned for the corn the next year. The legumes gave corn yields in decreasing order: Hairy vetch > biennial sweetclover > annual sweetclover > Korean lespedeza > Partridge pea. The first three of the six years were about normal in moisture. Plowing showed an advantage over stubble-mulching with each of the legumes. The last three years had lower rainfall, and subtillage gave an increase over plowing with each legume. In a number of tests fall subtillage for corn gave increased yields over delaying the subtillage until spring.

Applications of 60 to 80 pounds of nitrogen per acre gave corn yields on stubble-mulching as high or higher than on plowed land in non-legume rotations. Fertilizer nitrogen added to corn in sweetclover rotations gave only slight increases in yield. Oats yield was increased 17 to 20 bushels per acre in legume rotations compared with a non-legume rotation. Wheat yields were relatively good on this land. Yield in the non-legume rotation was 27.1 bushels per acre, and in the legume rotations, 32.6 bushels per acre. When eight years (1947-55) were compared in which the various rotations were all represented, the sweetclover rotations gave 10.3 bushels more wheat than the non-legume system. Manure at 8 tons per acre before oats gave an increase on wheat of 4.4 bushels per acre. There was no appreciable difference whether the manure was applied on the surface and the land subtilled or whether the manure was plowed under. It was found practical to prepare a good seedbed for wheat by the stubble-mulch system immediately after a sweetclover seed crop had been removed.

One year of sweetclover may deplete the soil of moisture in late fall and give poor soil moisture conditions for a spring crop in case the winter and spring are dry. It was practical to grow soybeans by the stubble-mulch method. Yields are about the same as with plowing. Also, they can be grown on sloping land under stubble-mulching with less danger of serious erosion than where the land is plowed. The protein content of grain crops was practically the same under plowing and stubble-mulching.

SWCRD, ARS, USDA and U. Nebr. Agr. Expt. Sta., Lincoln, Nebr.

Gamble, M. D. GROW WHEAT WITHOUT FEAR OF WIND OR WATER EROSION WITH STUBBLE MULCHING. Farmer-Stockman, Okla. Ed. 73(6): 12-13. 1960.

Stubble mulching is not a once-over, magic treatment of the land to protect it from wind and water erosion. Stubble mulching is a year round management of plant residues on cropland. Harvesting, seedbed preparation, planting, and cultivation are done in such a way as to leave protective amounts of residue from the previous crop on the surface until after the next crop is planted.

For effective control of wind erosion and to help control water erosion, the following amounts of residue are needed for each acre: 1,750 to 2,000 lbs. on sandy soils; 1,250 to 1,500 lbs. on medium textured soils, and 750 to 1,000 lbs. on hard lands.

The success of stubble mulch farming depends on: (1) A desire to protect the land; (2) knowing the amount of residue or stubble on land when seedbed preparation starts (general rule 100 lbs. for each bushel of wheat); (3) knowing the kind of soil and the protective amounts of residue needed on the surface at seeding time to control "average" wind erosion and reduce water erosion; (4) knowing the kind of equipment needed with the approximate percentage of residue with each tillage operation; and (5) knowing when to use equipment and how it should be adjusted.

Agronomist, SCS, USDA, Oklahoma City, Okla.

Power, J. F., and Hartman, G. P. PROBLEMS AND FUTURE OF CHEMICAL FALLOW. Farmer-Stockman, Mont. Ed. 47(19): 6. 1960.

Although the use of chemical herbicides on fallow is a relatively new practice in Montana, it is a practice that will probably become more common in future years. Presently developed chemicals do not give sufficiently consistent control to permit recommending a complete chemical fallow system. Therefore, improvement of the chemicals to be used remains the number one problem for this fallow system.

A chemical that will provide adequate weed control the major part of the fallow season without injuring the next year's crop is needed. Even then it appears that a limited amount of mechanical tillage will still be necessary.

SWCRD, ARS, USDA, Sidney, Mont.

Tillage

Gill, W. R. SOIL COMPACTION BY TRAFFIC. Agr. Engin. 40: 392-394, 400, 402. 1959.

A study of the traffic problem in terms of soil compaction suggests need for improved equipment design and farming practices.

In view of the fact that soil compaction by traffic is increasing and since it already exists in many locations, certain things can be done to remove or minimize the ill effects of soil compaction: (1) Avoid travel on the soil under those conditions which are conducive to soil compaction. If it is absolutely essential that an operation be conducted, one should attempt to remove as much of the compaction by tillage, i. e. with tines which follow the offending wheels to loosen the compacted wheel paths. (2) Eliminate unnecessary tillage or traffic from the soil. Obviously, the elimination of traffic must be balanced against other management considerations. (3) The use of new and improved equipment, which is designed with a specific aim of reducing soil compaction, will assist in reducing future soil compaction. And (4) proper management of the soil, which includes deep tillage to remove compacted layers in the soil and the use of deep rooted crops to help improve soil structure, is quite effective in overcoming some types of soil compaction. This type of management is generally as effective on dense soils which have been formed by traffic as it is to those dense soils which are formed genetically.

Natl. Tillage Mach. Lab., SWCRD, ARS, USDA, Auburn, Ala.

Flocker, W. J., Lingle, J. C., and Vomocil, J. A. INFLUENCE OF SOIL COMPACTION ON PHOSPHORUS ABSORPTION BY TOMATO PLANTS FROM AN APPLIED PHOSPHATE FERTILIZER. Soil Sci. 88: 247-250. 1959.

The present study was undertaken to investigate the effects of soil compaction on plant absorption of phosphorus from a phosphate fertilizer. Three soils were used: Yolo fsl, Salinas cl, and Hesperia sl. From the data presented it can be concluded that all three of these soils responded favorably to applications of phosphorus up to 200 pounds per acre as P_2O_5. The response was greater for the Hesperia soil series than for either of the other two.

Growth, as measured by fresh weight, decreased with compaction after a certain minimum compaction was attained and exceeded. Dryweight response was of the same order of magnitude.

Soil compaction as measured by changes in bulk density significantly reduced total uptake of phosphorus in tomato plants grown on both Yolo fsl and Hesperis sl. The total uptake of phosphorus in the tomato plant increased with increased fertilizer application in the two soils. The percentage of phosphorus in the plant that was derived from the fertilizer increased with fertilizer application, but compaction had no significant effect.

U. Calif., Davis, Calif.

Vicente-Chandler, J., and Silva, S. EFFECTS OF NITROGEN FERTILIZATION AND GRASS SPECIES ON SOIL PHYSICAL CONDITION IN SOME TROPICAL PASTURES. J. Agr. U. Puerto Rico. 44(2): 77-86. 1960.

The effect of intensive grazing on compaction of Catalina c and of Santa Isabel sicl as influenced by four grass species and the rate of nitrogen fertilization was determined.

Although both soils were compacted to some extent by grazing animals, the effect was not important and did not extend below the surface 3-inch layer.

Nitrogen fertilization reduced surface-soil compaction in Catalina c under Pangola-, Para-, and Napier- grasses, but not under Guineagrass, and resulted in increased percolation rates and volume of large pores in the 3-6-inch soil layer with all four grasses.

Surface-soil compaction by livestock was apparently less with Pangolagrass than with Guinea- or Napier- grasses. However, animal traffic is concentrated on the bare soil between clumps of the latter two grasses where the soil cores must be taken, and the untrampled surface under the clumps would have compensating effect.

Soil compaction by trampling does not appear to be a serious problem with well-fertilized pastures on the typical latosols of Puerto Rico's mountains, even at high stocking rates and with clump grasses.

SWCRD, ARS, USDA and U. Puerto Rico, Rio Predras, Puerto Rico.

Orr, H. K. SOIL POROSITY AND BULK DENSITY ON GRAZED AND PROTECTED KENTUCKY BLUEGRASS RANGE IN THE BLACK HILLS. J. Range Mangt. 13: 80-86. 1960.

Soils were sampled by 2-inch intervals to a depth of 12 inches inside livestock exclosure and on adjacent grazed range at each of four sites. The four sites are located in Kentucky bluegrass stream-bottoms grazed by cattle each year from June 1 to October 31. The soil cores were analyzed for bulk density and pore volume. Comparisons were made to determine whether there were differences in these soil properties between the exclosures and the adjacent grazed range.

Compaction was evident only within four inches of the soil surface. The entire surface 4-inch layer at two sites with soils of high silt plus clay content had significantly less large (60-centimeter) pore space and higher bulk density on the grazed range than inside the exclosures. At a third site where soil had slightly less clay and more sand, only the 0-2 inch soil layer had significantly less large pore space and higher bulk density on the grazed range than inside the exclosure. Soil at the fourth site had the least silt and nearly 50 percent sand. Here, the only soil difference attributable to compaction was significantly less pore space drained by 20-centimeter tension in the 0-2 inch layer on the grazed range than inside the exclosure. The amount of compaction appears to have varied directly with silt plus clay content of the soil.

The detection of soil compaction on the grazed range was dependent on recovery from compaction inside the exclosures. The exclosures were 5, 7, 9, and 17 years old. These appear to have been sufficient lengths of time for partial if not full recovery from soil compaction, except perhaps at the 5-year old exclosure.

Large pore space is more subject to sampling error than bulk density. Ten percent sampling error in bulk density of a 0-2, 2-4, or 4-6 inch layer inside an exclosure requires sampling at six random points. Only three random sampling points are needed for each 2-inch depth interval from 6- 12 inches an exclosure and from 0-1 inches on grazed range. To achieve a 10 percent sampling, 41 random points must be sampled for the 0-2 inch layer inside an exclosure and 35 points for each 2-12 inches inside an exclosure and 0-12 inches on grazed range. Both soil properties are more variable near the soil surface inside an exclosure than on grazed range.

Rocky Mountain Forest and Range Expt. Sta., FS, USDA, Rapid City, S. Dak.

Parr, J. F. EFFECTS OF VERTICAL MULCHING AND SUBSOILING ON SOIL PHYSICAL PROPERTIES. Agron. J. 51: 412-414. 1959.

Vertical mulching is a subsoiling practice in which organic residues are incorporated into subsoil channels. A study was conducted to evaluate the influence of vertical mulching compared to subsoiling on soil physical properties at different channel depths and at different distances from the channel. Samples were taken 10 and 14 months after treatment for the determination of bulk density, percent moisture, and aggregate analysis. It was concluded that: (1) The bulk density values for vertical mulching were significantly lower than for subsoiling; (2) in most cases the soil moisture values for vertical mulching were higher than for subsoiling; and (3) aggregate index values were usually higher for the vertical mulching treatment.

Purdue U. Agr. Expt. Sta., Lafayette, Ind.

Larson, W. E., Lovely, W. G., Pesek, J. T., and Burwell, R. E. EFFECT OF SUBSOILING AND DEEP FERTILIZER PLACEMENT ON YIELDS OF CORN IN IOWA AND ILLINOIS. Agron. J. 52: 185-189. 1960.

Subsoiling to 16 and 24 inches depth did not produce significant yield increases in 12 experiments on 7 important soil types in Iowa in 1955 through 1958. In 2 cases subsoiling to 24 inches depth decreased corn yields significantly. In Illinois in 1955, corn yields were increased significantly by subsoiling to 18 inches depth in 1 out of 8 experiments on 5 soil types. The residual effect of subsoiling increased yields at 1 of the 6 locations in 1956. Measurements at two locations in Iowa generally showed small and unimportant decreases in soil bulk density due to subsoiling.

Significant responses to fertilizer were obtained at two locations in Iowa. On an Ida soil under drouth conditions, phosphorus plus nitrogen produced insignificantly greater yield increases when plowed under than when placed in the subsoiled channel 20 inches deep. On a Webster-Glencoe soil, plowed-under phosphorus produced greater corn yields the first and second years and greater oat yields the third year after application than phosphorus placed 16 or 24 inches deep in the subsoiled channel.

SWCRD, ARS, USDA, Ames, Iowa.

Jamison, V. C., and Thornton, J. F. RESULTS OF DEEP FERTILIZATION AND SUBSOILING ON A CLAYPAN SOIL. Agron. J. 52: 193-195. 1960.

Several experiments are reported on the deep tillage, subsoil liming, and fertilization on Mexico sil for alfalfa, small grain, and row crops. Subsoil shattering by plow sole tillage alone tended to depress yields of wheat, corn, and soybeans; while applications of lime and rock phosphate to the plow sole before shattering evidently overcame the detrimental effect of plow sole tillage. Deep treatment with lime and rock phosphate by this method was beneficial to sweet clover rooting and growth and gave small residual increases in alfalfa production 8 to 10 years after the treatment. Subsoil treatment with lime or lime plus triple-superphosphate by plow sole application, split surface applications with two 12-inch plowings, or by placement in subsoiler clefts were tested for corn and alfalfa production. When the soil surface was adequately fertilized, the yield increases for deep treatment were small and not of practical significance from the economic viewpoint. Small but statistically significant four-year average increases in corn yields were obtained for subsoil liming by the plow sole tillage method or by placement in the subsoiler clefts. Phosphate in the subsoiler clefts with lime significantly reduced the effect of lime on corn yields but supplemented the effect of lime on alfalfa. Deep-placed lime appeared to have little effect on alfalfa except when applied with phosphate on the plow sole or in the subsoiler clefts. The plow sole tillage method of applying lime to the subsoil was the most effective method used. The increased productivity obtained for deep fertilization of any of the crops tested was not sufficient to be of practical significance.

SWCRD, ARS, USDA, Columbia, Mo.

Peterson, A. E. RENEWING PERMANENT PASTURES WITH MINIMUM SOIL TILLAGE. J. Soil and Water Conserv. 15: 76-78. 1960.

In 1957, a study was started to see if interseeding of alfalfa in corn and wheel-track planting of corn could be combined to re-establish successfully pasture in one growing season and obtain a crop of corn.

Excellent alfalfa cover was obtained by August 15, 1957, only 5 weeks after the alfalfa was seeded and two months after the field had been plowed and corn planted. Adequate plant food, good seeding methods, and absence of weeds made this growth possible.

The corn yields (Table 1) indicate that both the 40-inch and 60-inch rows produced excellent yields, certainly comparable to regular corn fields in the area. Some of the yield differences are due to difficulties of obtaining as large a plant population in the 60-inch rows as in the 40-inch rows. The dwarf corn planted in 1958 did not fully mature, resulting in a lower yield.

Table 1.--Yield and population of wheel-track planted corn on pasture renewal experiment, Sogn silt loam soil, Iowa County, Wisconsin, 1957 and 1958

Row Width	1957[1]		1958[2]	
	Plants/A	Yield	Plants/A	Yield
40"	17,200	86.0	19,000	104.2
60"	14,900	74.1	17,300	102.8
40" Dwarf[2]	--	--	19,300	92.0

[1] Average of duplicate plots.

[2] Brachytic type dwarf corn.

The alfalfa stand counts and forage yields indicate that satisfactory alfalfa stands were obtained in all treatments. The stand counts in the 40-inch rows of dwarf corn were about equal to those in the 60-inch rows of regular corn. The alfalfa seeded in 40-inch rows of regular corn was not as vigorous during the seeding year as the alfalfa seeded in the 60-inch corn rows. This is reflected by the reduced yields during the first year of pasture. Growth difference was not nearly as apparent by the fall of the first pasture year as it had been in the spring.

The yield of corn, stand of alfalfa, and light intensity indicates that alfalfa-brome may be re-established in one growing season on permanent pasture using minimum soil tillage methods. Best results were obtained from seedings made when the corn was 8 to 12 inches tall and where weeds were not a problem.

U. Wisc., Madison, Wisc.

Free, G. R. MINIMUM TILLAGE FOR SOIL AND WATER CONSERVATION. Agr. Engin. 41: 96-99, 103. 1960.

For any new tillage practice or combination of practices, benefits should balance or exceed costs if there is to be widespread acceptance and use. In the case of minimum tillage, there appears to be the possibility of reducing costs and also gaining benefits from the standpoint of soil and water conservation.

Minimum tillage for corn appears to have originated in Ohio and then spread to Michigan and other areas where corn is an important crop. Minimum tillage may be defined as the least possible manipulation of the soil for satisfactory planting, germination, stands, growth, and yields of a crop. The usual approach has been to endeavor to eliminate or to reduce the severity of some of the operations and traffic associated with conventional seedbed preparation which usually includes plowing, followed by harrowing or disking, and soil packing.

Minimum tillage, which leaves as much of the soil as possible coarse, rough, and uncompacted, should have definite advantages from the standpoint of control of runoff and erosion.

More information is needed on the place and limitations of the various kinds of minimum tillage. Minimum tillage will not make good soil structure, but will merely help preserve it for useful purposes if present in the untilled soil.

The object of this paper is to discuss the practice of minimum tillage for soil and water conservation from the following standpoints: (1) Reasons for the current interest in the practice; (2) some requirements that should be considered; and (3) the present status of development of the practice in New York state.

Minimum tillage for large seeded field crops, such as corn, is feasible and practical under New York conditions.

SWCRD, ARS, USDA, Ithaca, N. Y.

Haynes, J. L., Johnson, W. H., and Stringfield, G. H. PLANTING METHODS FOR IMPROVED STANDS OF CORN AND SOYBEANS ON CLAY AND SILT-LOAM SOILS. Agron. J. 51: 640-642. 1959.

The use of furrow openers, press wheels, and soil knives on corn planters resulted in more prompt and more uniform germination and emergence of corn and soybeans when unfavorable weather followed planting on clay soils. When winter-plowed clay was dry and loose on the surface but plastic below 2 or 3 inches at planting time, the use of furrow openers was advantageous and pressing the seed into moist soil gave further benefit.

The reduction of voids in the seedbed by tillage and compaction and pressing the seed into the soil were advantageous on spring-plowed clay.

The experiments on silt-loam gave faster seedling emergence as a result of compaction and void reduction in the seed row over and above that obtained through normal seedbed preparation.

Ohio Agr. Expt. Sta., Wooster, Ohio.

Rowe, R. J., and Lovely, W. G. A LISTER PLANTER ATTACHMENT FOR SIDE-BAND PLACEMENT OF STARTER FERTILIZER. U.S.D.A., A.R.S. 42-46, 6 pp. 1959.

Numerous experiments have shown listing to be a desirable tillage method for the production of corn. It is efficient from a labor standpoint, and when used on the contour is an excellent soil and water conservation measure. In the Great Plains region, where rainfall is often the limiting factor, corn yields from listing have been equal to or better than yields from conventional planting methods. Listed corn, however, is slow in starting. The young plants are yellow and grow slowly for some time after emergence. Stands of listed corn are often poorer than those obtained with other methods, sometimes resulting in lowered yields.

While it is realized that fertilizer is not the whole answer to this problem, it does seem likely that properly placed starter fertilizer can do much to improve the emergence and early-season growth of listed corn.

When applied with most existing equipment, starter fertilizer is merely dropped in the lister furrow or at best placed in a shallow band close to the seed. Conventional planting methods have shown that maximum use of fertilizer by the corn plant occurs when the fertilizer is applied in a band 1 to 2 inches to one side of the seed and about 2 inches lower than the seed. Two reasons are given for the improved response obtained with side-band placement of fertilizer. It enables plants to make more use of fertilizer phosphorus by retarding fixation loss, and it prevents poor stands caused by too much nitrogen coming in contact with the seed.

A lister planter attachment for side-band placement of starter fertilizer is described and illustrated.

Field tests have shown that the modified lister planter will satisfactorily band-place fertilizer 2 inches to the side and 2 inches lower than the seed.

AERD, ARS, USDA and J. Paper J3597, Iowa Agr. and Home Econ. Expt. Sta., Ames, Iowa.

Phillips, R. E., Jensen, C. R., and Kirkham, D. USE OF RADIATION EQUIPMENT FOR PLOW-LAYER DENSITY AND MOISTURE. Soil Sci. 89: 2-7. 1960.

Radiation probes for determining the approximate plow-layer density and moisture content of soil in place were tested in two field experiments, and the values obtained with the probes were compared with values obtained from core samples taken with a power-driven, undisturbed-core sampler. The comparisons showed that about three times as many determinations of the bulk density of the approximate plow layer could be made in the same time using radiation equipment as could be made using the core sampler. The precision of the two methods was found to be about the same, ±0.054 g./cc. for the core method and ±0.061 g./cc. for the radiation method. To obtain comparable values by both the core and radiation method, a constant value of 0.10 g./cc. had to be subtracted from the radiation values of density as obtained from the company calibration curves, and a value of 0.05 g./cc. had to be added to the radiation values of moisture content as obtained from the company curves. In view of the results obtained with the radiation equipment, the comparable rapidity with which it can be used, and the fact that the soil remains undisturbed, it is concluded that this equipment should be useful in comparing densities and moisture contents in the plow layer under various management and tillage treatments and probably in other investigations involving a shallow layer of soil.

J. Paper J-3644, Iowa Agr. and Home Econ. Expt. Sta., Ames, Iowa.

Fesko, K., and Strugaleva, E. V. USE OF DEEP PLOWING FOR REGULATING THE WATER AND SALT REGIME IN SOILS OF THE ALEYSK IRRIGATION SYSTEM. Soviet Soil Sci. 1: 96-104. Jan. 1959.

Southern chernozems on coarse and moderately silty clay in the Aleysk Irrigation System became quickly compacted after rainfall and especially after irrigation, rapidly losing their porosity brought about by deep tillage. For that reason deep plowing must be done more often when soils are irrigated.

Deep plowing with and without turning over the soil creates better conditions for storing moisture from winter and summer rains and insures better distribution of irrigation water throughout the soil profile in the first year. Drying of the soil to the tilled depth is observed in a dry period after plowing.

Deep plowing with subsoiling, especially plowing without turning over the soil, has a positive effect on the salt regime of the soil making more intensive desalinization possible after precipitation and irrigation than with ordinary plowing. Concentration of the soil solution in the 0-20 cm (0-8 inch) layer, which is almost toxic, is thereby reduced to a permissible level. With ordinary plowing the concentration of soil solution is 2.3%, with subsoiling 2.1%, and without turning over the soil 1.7%. With all forms of plowing the degree of salinity was reduced from strongly saline to moderate.

In the first year deep plowing of irrigated lands creates more favorable conditions for plant growth and helps to raise the yield of sugar beets, especially of seeds.

Amer. Inst. Biol. Sci., 2000 P St. N.W., Washington 6, D.C.

Patrick, W. H., Jr., Sloane, L. W., and Phillips, S. A. RESPONSE OF COTTON AND CORN TO DEEP PLACEMENT OF FERTILIZER AND DEEP TILLAGE. Soil Sci. Soc. Amer. Proc. 23: 307-310. 1959.

Deep placement of fertilizer and deep tillage were evaluated as to their effect on crop yields and root development. Experiments conducted for several years on four soil types showed that greater root development in the subsoil and increases in yield may be expected from deep fertilizer placement and deep tillage on soils that possess traffic pans.

This was particularly evident in years of below average rainfall, when the increased root development in the subsoil caused by deep placement of fertilizer or deep tillage enabled the crop to better withstand dry periods.

La. Agr. Expt. Sta., Baton Rouge, La.

Fertility Requirements for Conservation Farming

Morgan, N. D. PLANT TESTS AND PLANT TISSUE TESTS. Better Crops With Plant Food 44(3): 4-6, 13. 1960.

When and how to use plant tests and plant tissue tests are discussed.

The plant itself is the best indicator of the availability of the elements in the soil vital to its nutrition under the conditions which it is growing, since it is the plant that extracts those elements from soil and utilizes them.

The plant should certainly be checked at the time of the greatest demand for plant nutrients to see if it is adequately supplied at that time.

Plant-tissue tests are easy to make in most cases, but the real problem is in the interpretation of the results obtained.

A test for N, P, or K alone means very little. A check for all three elements is absolutely necessary before the proper interpretation can be made. If any one of these plant foods becomes limited in the plant, there may be an accumulation of one or both of the other elements. That is, if the test shows nitrogen to be absent, phosphorus and potash may be found in the plant even though the soil is very low in these elements.

Shreveport, La.

Seatz, L. F., Sterges, A. J., and Kramer, J. C. THE INFLUENCE OF ORGANIC MATTER ADDITIONS ON ROCK PHOSPHATE AVAILABILITY TO CROPS. Soil Sci. Soc. Amer. Proc. 23: 374-376. 1959.

A greenhouse experiment was conducted to evaluate the effects of adding organic matter to the soil on the availability of rock phosphate from two sources. The treated soils were cropped successively to Sudangrass, ryegrass, and two crops of red clover. Treatments receiving additions of organic matter yielded higher in most cases than the corresponding treatment without added organic matter. Increased yields were attributed to the additional P in the organic matter rather than to the beneficial effect of the organic matter on the availability of rock phosphate. Treatments receiving Florida rock phosphate yielded more than corresponding treatments receiving Tennessee rock phosphate.

Tenn. Agr. Expt. Sta., Knoxville, Tenn.

Karpinskiy, N. P., and Zamyatina, V. B. THE PHOSPHATE LEVEL OF THE SOIL. Soviet Soil Sci. 1213-1223. Nov. 1958.

In a study of the phosphate level of the soil the authors make the following conclusions:

1. The term "phosphate level of the soil" is defined as follows: in the interaction of two soils through a solution, phosphate ions pass spontaneously from the soil with the higher to the soil with the lower phosphate level; when this system is in equilibrium, the phosphate levels of the soils are equal.
2. The criterion of the phosphate level is the magnitude of the P_2O_5 concentration in the salt or water extract (when there is a narrow soil-solution ratio).
3. When phosphorus is removed from the soil by means of an anionite there is a decrease in the magnitude of the equilibrium concentration of P_2O_5 in the water extract from the soil.
4. During the pot experiments with oats and spring wheat, decreases were observed in the magnitudes of the P_2O_5 concentrations in water and salt extracts from the soil. The quantities of phosphorus extracted from the soil by the anionite and by the plants were on the same order (as long as the soil's phosphate level was the same after the extraction); these data suggest some similarity between the processes involved in the removal of phosphorus by plant and by the anionite.

5. The phosphate level which has dropped as a result of the removal of phosphorus by the plants is restored if the soil is subsequently maintained for a long time in a friable and moist condition (fallowing).

Amer. Inst. Biol. Sci., 2000 P St. N.W., Washington 6, D.C.

MacKay, D. C., and Eaton, J. B. THE PENETRATION OF RADIOACTIVE SUPERPHOSPHATE INTO A PODZOL SOIL. Canad. J. Soil Sci. 39: 215-231. 1959.

The penetration into the soil of phosphorus, applied as superphosphate, was determined under various conditions in a field experiment on Cornwallis s. Monocalcium phosphate containing P^{32} was thoroughly incorporated in the surface inch, and the activity was later determined in 1-inch segments of core samples.

Movement downward of applied phosphorus was very slight in spite of the coarse texture of this soil. In 2 weeks an average of 5.2 percent was located in the 2-6 inch zone and only 8.5 percent had reached this depth in 4 weeks. Application of 2 inches of water per week (rainfall plus irrigation) produced no significant difference from 1 inch per week. Neither adjustment of pH levels with dolomitic limestone, nor increasing the organic matter levels with anthraxylate (a humus-like material prepared from coal) had any significant effect on phosphorus migration.

There was some evidence that increased rates of superphosphate resulted in greater penetration of phosphorus but the effect was not statistically significant. Even the heaviest rate of phosphorus used (800 lbs. /ac. of P_2O_5) did not saturate this soil appreciably, as it has a high phosphorus retention capacity (28.7 tons/acre).

Res. Sta., Canada Agr., Kentville, Nova Scotia, Canada.

Cho, C. M., and Caldwell, A. C. FORMS OF PHOSPHORUS AND FIXATION IN SOILS. Soil Sci. Soc. Amer. Proc. 23: 458-460. 1959.

A determination of the main forms of P, P fixation, and a comparison of several methods of determining available P were made on several Minnesota soils.

Inorganic and organic forms of P were characterized and the inorganic fraction was further subdivided into aluminum phosphate, iron phosphate, and calcium phosphate. Fractionation data of the inorganic P showed that iron and aluminum phosphates were abundant in acid soils while calcium phosphate was abundant in alkaline soils. In soils having a pH near 7, all three forms of inorganic phosphorus were about equally distributed, though slightly more iron and aluminum than calcium phosphate was present. Organic P agreed, in general, with the content of soil organic matter.

The capacity of the soils to "fix" P from added KH_2PO_4 was observed. It was found that the P-fixing capacity of soils increased with departure from a pH near neutrality.

Bray No. 1 and 2, $NaHCO_3$, citric acid, Morgan's, and water-solubility methods of determining available P were compared. Available P in the soils varied greatly depending upon the extraction procedure used. Generally the amounts of available P as determined by methods employing strong acids were higher than those using weak acids. Correlation analysis was carried out on forms of P and the amount of P as determined by the various quick methods.

Minn. Agr. Expt. Sta., St. Paul, Minn.

Larsen, J. E., Warren G. F., and Langston, R. EFFECT OF IRON, ALUMINUM AND HUMIC ACID ON PHOSPHORUS FIXATION BY ORGANIC SOILS. Soil Sci. Soc. Amer. Proc. 23: 438-440. 1959.

Studies were conducted comparing the effects of Fe, Al, and humic acid on P fixation in two organic soils which had undergone different degrees of decomposition. It was shown that organic soils fix P similarly to other reported P-fixing systems. Fe and/or Al additions increased phosphate fixation while humic acid resulted in an apparent negative absorption. Further, humic acid prevented absorption of P in the presence of limited quantities of Fe and Al.

J. Paper 1250, Purdue U. Agr. Expt. Sta., Lafayette, Ind.

Phillips, M. W., and Barber, S. A. ESTIMATION OF AVAILABLE SOIL POTASSIUM FROM PLANT ANALYSES. Agron. J. 51: 403-406. 1959.

Results from greenhouse and field experiments indicate that total potassium uptake is a more precise measurement of available soil potassium than is the percent potassium in the whole plant or in the sixth leaf. Total uptake of potassium varied less with variations in nitrogen, phosphate, and plant weight than did percent composition.

J. Paper 1343, Purdue U. Agr. Expt. Sta., Lafayette, Ind.

Ellis, B. G., and Mortland, M. M. RATE OF POTASSIUM RELEASE FROM FIXED AND NATIVE FORMS. Soil Sci. Soc. Amer. Proc. 23: 451-453. 1959.

The rate of release of K from fixed and native forms was compared utilizing a biotite-vermiculite system. Although X-ray diffraction patterns of oriented aggregates showed little difference between native biotite and weathered biotite containing fixed K, there was a marked difference in the rates of K release from the two materials. The release from native biotite was maintained at nearly a constant rate while approximately 50% of the K was removed, whereas with the fixed forms, rate of release decreased with time. The relationship between the logarithm of the rate of release and time was linear. The slopes of these curves were directly related to the extent of weathering which the weathered biotite had undergone before being subjected to the fixation reaction. The ease of release of fixed K therefore appears to be a function of the extent of weathering of the mica. This may be the result of loss of charge in the mineral during weathering.

Mich. Agr. Expt. Sta., East Lansing, Mich.

Bartlett, R. J., and McLean, E. O. EFFECT OF POTASSIUM AND CALCIUM ACTIVITIES IN CLAY SUSPENSIONS AND SOLUTIONS ON PLANT UPTAKE. Soil Sci. Soc. Amer. Proc. 23: 285-289. 1959.

The clay membrane electrode was used to evaluate average activities of K and Ca in clay suspensions and in solutions throughout an 11-day growth period. Uptake of K and Ca by soybeans, barley, and buckwheat was compared in bentonite and Putnam clay suspensions and in solutions with the same cationic activities. The media were changed frequently to maintain relatively constant K and Ca activities. The other essential elements were supplied by periodically placing the plants in solutions containing Mg, N, P, S, and Fe.

In soybeans and barley, both yield and percentage of K were higher in clays than in solutions of equal or even higher activities, but were not significantly different between clays. At the levels tested, K uptake was more closely related to total amount present than to activity. There was no evidence that bonding of exchangeable K regulated uptake.

It was shown that bonding of Ca by clays may have regulated uptake. All plants removed as much or more Ca from solution as from suspension of equal activity. In soybeans, uptake of Ca was proportional to the Ca activity in the medium, while in barley and buckwheat, Ca uptake of this element was greater from solution than from clays, even when the Ca activities in both media were equal. The order of Ca accumulated was buckwheat > soybeans > barley. Some evidence was noted from contact interaction between root and clay colloids in both K and Ca uptake.

J. Article 109-58, Ohio State U., Ohio Agr. Expt. Sta., Columbus 10, Ohio.

Hutchinson, T. B., Jr., McCaleb, S. B., and Woltz, W. G. POTASSIUM-SODIUM INTERRELATIONSHIPS: II. POTASSIUM AND SODIUM INTERACTIONS IN MINERAL SYSTEMS. Soil Sci. 88: 36-44. 1959.

Laboratory investigations of the effect of various solutions upon the release of sodium, potassium, and calcium from crushed granitic and feldspathic materials suggested that most of the release was the result of the solvent action of the solutions. When total release of the three elements was considered, the order of solubility for the mineral materials appeared to be granite > high Na feldspar > high K feldspar. Release of the individual elements by the materials was affected by the solutions in which they were placed.

Potassium release was greatest to solutions that were low in potassium or those that contained none at all. In all cases more potassium was released either by the granite or the high K feldspar than by the Na feldspar.

The order of the mineral materials for sodium release was high Na feldspar > granite > high K feldspar. Calcium was released in greatest quantities by the granite: Na feldspar came next, and high K feldspars released least. Sodium and calcium release appeared to be encouraged by the presence of potassium in the solutions.

Greenhouse investigations conducted in conjunction with the laboratory studies revealed that the potassium content of the plants appeared to be more affected by the mineral materials in which they were grown than would be expected after examination of the laboratory data. Plants grown in the granitic and feldspathic materials high in potassium contained considerably more potassium than did plants grown in the quartz or high sodium feldspar sands, particularly when sodium was supplied at low levels of potassium in nutrient solutions.

For any given treatment, the concentration of potassium was approximately the same in the leaves and stalks of the tobacco plant but considerably lower in its roots. The concentrations of sodium, however, was about the same in roots and stalks but considerably lower in leaves.

The results from this study do not suggest use of any of the mineral materials as a practical source of potassium for fertilizing purposes. They further suggest little, if any, practical effect of sodium in the production of tobacco.

N. C. J. Ser. Paper 895, N. C. Agr. Expt. Sta., Raleigh, N. C.

Hovland, D., and Caldwell, A. C. POTASSIUM AND MAGNESIUM RELATIONSHIPS IN SOILS AND PLANTS. Soil Sci. 89: 92-96. 1960.

Potato and sugar beet foliage on K-fertilized plots was not as dark green as that on plots not so treated. It was suggested that this might be due to a lessened Mg content induced by high K.

Relationships of K fertilization, plant content of Mg and K, and ease of replacement of soil Mg were studied with soil and plant samples. Mg content was found to be lower in plants grown on soils treated with K than in plants from untreated soils. The 1/2 p Mg-pK values which reflect ease of replacement of soil Mg by K were calculated from concentrations of K and Mg in saturation extracts. These values increased with K fertilization in three experimental soils, but not in a fourth. Increase in values coincided with a reduction of Mg in the crop.

U. Minn., Agr. Expt. Sta., St. Paul, Minn.

Neller, J. R. EXTRACTABLE SULFATE-SULFUR IN SOILS OF FLORIDA IN RELATION TO AMOUNT OF CLAY IN THE PROFILE. Soil Sci. Soc. Amer. Proc. 23: 346-348. 1959.

Sulfate-S was extracted from the profiles of a number of uncropped soils, using samples obtained in soil surveys. The extractant used was sodium acetate adjusted to pH 4.8 with acetic acid.

Little or no sulfate-S was found in the surface horizons of the soils studied but considerable amounts were present in many of the subsurface layers. These deposits of sulfate-S were found generally where clay was present in the profile. The amounts of sulfate-S increase with increase in clay in a highly significant manner and generally at a much greater rate of increase. There appears to be some relation between amounts of sulfate and types of clay.

Rainfall on these soils adds about 5 pounds of S annually per acre and much of this sulfate probably leaches down through the sandy surface layers that characterize many of the soils of Florida.

U. Fla., Agr. Expt. Sta., Gainesville, Fla.

Jordan, J. V., and Baker, G. O. SULFUR STUDIES IN NORTH IDAHO SOILS USING RADIOSULFUR. Soil Sci. 88: 1-6. 1959.

The techniques developed and results obtained in an attempt to gain information about crop response and sulfur utilization in northern Idaho are given.

A green manure crop of peas furnished amounts of sulfur to a growing crop of beans that were comparable to amounts furnished by inorganic sulfur sources.

Gypsum, commercial ferrous sulfate, ammonium sulfate, green manure peas, and elemental sulfur were tagged with radiosulfur for a greenhouse experiment on Palouse sil and Mission sil. These treated soils were cropped with beans to determine the uptake of sulfur from the fertilizer materials. The residual effect of these materials was studied with a second crop. The first crop of beans contained more radiosulfur from green manure and ferrous sulfate. Elemental sulfur furnished more sulfur for the second crop but was, in both cases, the least effective treatment.

In field experiments at Moscow, the residual effects of applying gypsum and elemental sulfur were studied for 2 years on alfalfa, and on wheat followed by peas.

There were economic yield increases of alfalfa through using sulfur fertilizers over a 7-year period. Winter wheat following this period of treatment yielded economic gains.

When tagged gypsum and sulfur were applied at the rate of 30 pounds sulfur per acre in 1954, alfalfa recovered 21.73 pounds of sulfur from the single gypsum application over a 3-year period and only 9.31 pounds from the elemental sulfur application. Wheat followed by peas, over a 2-year period, utilized 12.10 pounds of sulfur from the single gypsum application and 5.67 pounds from elemental sulfur.

U. Idaho, Agr. Expt. Sta., Moscow, Idaho.

Seatz, L. F., Sterges, A. J., and Kramer, J. C. CROP RESPONSE TO ZINC FERTILIZATION AS INFLUENCED BY LIME AND PHOSPHORUS APPLICATIONS. Agron. J. 51: 457-459. 1959.

The effects of rate of liming, composition of the liming material, and rate of phosphorus fertilization on the response of flax and sorghum to zinc fertilization were studied using a Hartsells l. The two crops were grown in a room with controlled light and temperature. Yield and chemical composition of the plant material were determined. As the liming rate increased from 2 to 8 tons per 2 million pounds of soil the severity of zinc deficiency increased without zinc fertilization. Maximum response to zinc fertilization occurred at the 6-ton rate. Phosphorus fertilization up to 1000 pounds of P_2O_5 per 2 million pounds of soil resulted in significantly increased yields but had no influence on zinc response.

By altering the $CaCO_3/MgCO_3$ mole ratio of the liming material at a constant liming rate it was found that the optimum ratio was 2/1.

In general, zinc fertilization resulted in significant reductions in the P, K, Ca, and Mg contents of the plants.

The Ca/Mg ratio of ammonium acetate soil extracts closely approximated the Ca/Mg ratio of the flax at the narrow $CaCO_3/MgCO_3$ ratios. At wider ratios the plants were able to absorb proportionally more Mg than was found in the soil extracts.

Tenn. Agr. Expt. Sta., Knoxville, Tenn.

Brown, J. C., Holmes, R. S., and Tiffin, L. O. HYPOTHESES CONCERNING IRON CHLOROSIS. Soil Sci. Soc. Amer. Proc. 23: 231-234. 1959.

Iron chlorosis was studied in two plant species grown on calcareous Quinland, Tripp, and Millville soils. Two types of Fe chlorosis developed: (1) Iron deficiency accentuated by improper microelement balance appeared to be the causative factor controlling the development of Fe chlorosis in milo grown on Quinland and Tripp soils. The Cu uptake by milo from all three soils and two NaDTPA chelate treatments was more than double that taken up by Pl-54619-5-1 and Hawkeye soybeans. The Fe/Cu + Mn ratio was much lower in the soil extracts of Quinland and Tripp than the Millville soil. And (2) an abundance of available P and Ca appeared to be the controlling causative factors of Fe chlorosis in Pl-54619-5-1 soybeans grown on the Millville soil. Pl-54619-5-1 and Hawkeye soybeans differed in their susceptibility to this type of chlorosis. It was suggested that new chlorosis-resistant varieties through plant breeding, Fe chelates economically feasible for field application, controlled fertilizer, water, and cultural practices might all lend themselves to correcting Fe chlorosis in the field.

SWCRD, ARS, USDA, Beltsville, Md.

Berger, K. C. TRACE ELEMENTS CAN MAKE THE DIFFERENCE. Hoards Dairyman 105: 515-516. 1960.

This article describes the symptoms of various plants deficient in the trace elements of boron, copper, zinc, manganese, iron, and molybdenum and describes how the deficiency can be corrected.

The author concludes that trace elements are needed for top yields.

U. Wisc., Madison, Wisc.

Bingham, F. R. MICRONUTRIENT CONTENT OF PHOSPHORUS FERTILIZERS. Soil Sci. 88: 7-10. 1959.

In 1951 phosphorus deficiency in field-grown citrus in certain areas of southern California was first recognized. As a consequence, many growers began to use phosphorus fertilizers, and often in quantities exceeding 500 pounds P_2O_5 per acre. That phosphorus interactions might occur under such conditions of heavy fertilization with phosphorus is definitely a possibility.

Comparative results of fertilizers produced in the Western States and Canada and those produced in the Southern States are presented.

Phosphates from the Western United States very definitely differ with regard to Zn content from those produced in the Southeastern United States. The four acid samples obtained from western or Canadian producers contained an average of 1,000 p.p.m. Zn, while the eastern-produced acids averaged less than 200 p.p.m. Comparable Zn contents were found in the dry fertilizers. The western single and treble superphosphates averaged over 1,350 p.p.m. Zn, the range being from 989 to 1813 p.p.m. The western ammonium phosphates, such as 16-20, 11-48, 13-39, and 24-20, were, in general, somewhat lower in Zn than the superphosphates, averaging 656 p.p.m. Zn. In contrast, the eastern dry fertilizer contained an average of 156 p.p.m. Zn.

Boron contents of the western fertilizers average 25 and 51 p.p.m. for the acids and dry fertilizers, respectively. The eastern phosphates contained somewhat larger amounts but, in general, still less than 100 p.p.m. The Cu values of the western fertilizers (both liquid and dry) were similar, approximately 50-60 p.p.m. The eastern phosphates contained appreciably less, namely 15 and 20 p.p.m. Cu. Manganese averaged 200 to 300 p.p.m. Mn in both the western- and eastern-produced samples. Molybdenum was low in all samples; most values were less than 20 p.p.m.

The chemicals, H_2PO_4 and $Ca(H_2PO_4)_2$, were especially pure; only traces of the elements were detected.

The acid or treble superphosphate produced with phosphoric acid made by the electric furnace process was definitely lower in B, Mn, Mo, and Zn than fertilizers made with wet process acids.

U. Calif., Citrus Expt. Sta., Riverside, Calif.

Bear, F. B. SYMPOSIUM ON BICARBONATES. Soil Sci. 89: 241-302. 1960.

This May issue of Soil Science contains the papers presented at the Symposium at the Pacific Division, American Association for the Advancement of Science, San Diego, California, June 15-19, 1959. This symposium was sponsored by the Western Society of Soil Science and the western Section of the American Society for Horticulture Science.

The following is author, title, and address of author of each paper presented:

Miller, G. W. CARBON DIOXIDE-BICARBONATE ABSORPTION, ACCUMULATION, EFFECTS ON VARIOUS PLANT METABOLIC REACTIONS, AND POSSIBLE RELATIONS TO LIME-INDUCED CHLOROSIS. Utah State Agr. Expt. Sta., Logan, Utah.

Brown, J. C. AN EVALUATION OF BICARBONATE-INDUCED IRON CHLOROSIS. SWCRD, ARS, USDA, Beltsville, Md.

Rhoads, W. A., and Wallace, A. POSSIBLE INVOLVEMENT OF DARK FIXATION OF CO_2 IN LIME-INDUCED CHLOROSIS. U. Calif., Los Angeles, Calif.

Bedri, A. A., Wallace, A., and Rhoads, W. A. ASSIMILATION OF BICARBONATE BY ROOTS OF DIFFERENT PLANT SPECIES. U. Calif., Los Angeles, Calif.

Huffaker, R. C., Clark, R. B., Mueller, R. R., and Wallace, A. RELATIVE IMPORTANCE OF BICARBONATE VS CARBON DIOXIDE IN REACTIONS, INCLUDING $KHCO_3$ ACCUMULATION BY BUSH BEANS. U. Calif., Los Angeles, Calif.

Doney, R. C., Smith, R. L., and Wiebe, H. H. EFFECTS OF VARIOUS LEVELS OF BICARBONATE, PHOSPHORUS, AND pH ON THE TRANSLOCATION OF FOLIAR-APPLIED IRON IN PLANTS. Utah State U., Logan, Utah.

Bhan, K. C., Huffaker, R. C., Bedri, A. A., Mueller, R. T., Jeffreys, R. A., Carmack, R. R., Biegly, M. I., and Wallace, A. POSSIBLE RELATIONSHIP OF BICARBONATE OR CO_2 ASSIMILATION TO CATION ACCUMULATION BY PLANT ROOTS. U. Calif., Los Angeles, Calif.

Hale, V. Q., and Wallace, A. BICARBONATE AND PHOSPHORUS EFFECTS ON UPTAKE AND DISTRIBUTION IN SOYBEANS OF IRON CHELATED WITH ETHYLENEDIAMINE DI O-HYDROXYPHENYL ACETATE. U. Calif., Los Angeles, Calif.

Olsen, S. R., Watanabe, F. S., and Cole, C. V. EFFECT OF SODIUM BICARBONATE ON THE SOLUBILITY OF PHOSPHORUS IN CALCAREOUS SOILS. SWCRD, ARS, USDA, Fort Collins, Colo.

Clark, R. B., Blank, G. B., Hale, V. Q., and Wallace, A. BEHAVIOR OF BICARBONATE AND Sr85 IN SOILS. U. Calif., Los Angeles, Calif.

Goss, J. A. AMMONIUM BICARBONATE IN PLANT NUTRITION. Kans. State U., Manhattan, Kans.

Kresge, C. B., and Satchell, D. P. GASEOUS LOSS OF AMMONIA FROM NITROGEN FERTILIZERS APPLIED TO SOILS. Agron. J. 52: 104-107. 1960.

Ammonia volatilization from several nitrogen fertilizers applied to soils was determined with closed systems in the laboratory and outdoors in direct sunlight. Various moisture, fertilizer, and plant cover treatments were used. Large losses of ammonia occurred from surface applications of urea and calcium cyanamide to bare soils at rates of 100 pounds of nitrogen per acre. No ammonia was volatilized from ammonium nitrate or ammonium sulfate as long as the soil pH did not rise above neutral. More ammonia was lost from urea on soils drying out from field capacity than from any other moisture content. The soil moisture content at which most ammonia was lost from calcium cyanamide was above field capacity.

Ammonium nitrate mixed with urea in concentrated solutions reduced ammonia volatilization considerably as compared with urea alone in solution. Allowing urea to diffuse rapidly into the soil, either by watering in or by preventing evaporation reduced ammonia losses. Urea topdressed on Coastal bermudagrass gave significantly lower losses than that topdressed on bare soil. Precautions should be taken when topdressing urea at rates above 100 pounds of nitrogen per acre to provide for rapid diffusion of the urea into the soil.

J. Paper 2341, Pa. Agr. Expt. Sta., University Park, Pa.

Iritani, W. M., and Arnold, C. Y. NITROGEN RELEASE OF VEGETABLE CROP RESIDUES DURING INCUBATION AS RELATED TO THEIR CHEMICAL COMPOSITION. Soil Sci. 89: 74-82. 1960.

The constant-air-flow, pot, and flask methods of incubation were used in these studies to determine the relationship between the chemical composition of vegetable residues and the accumulation of mineral nitrogen.

Except for two instances, the average amounts of total nitrogen released from all of the incubated residues were shown to be quite similar, regardless of the incubation method used.

Compared to the other two methods, the nitrogen release from corn residues in the pots was much lower. This suggested the possibility that some factor associated with the decomposition of corn residues was inhibiting the uptake of nitrogen by the tomato plants.

Ammonia accumulations were quite high and variable. The unusually high values could probably be explained by partial sterilization caused by the air-drying of the soil, which is reputed to affect the nitrifying bacteria.

Multiple and simple correlation and regression analysis of the chemical composition of the residues and the accumulation of mineral nitrogen revealed the following:

(1) Nitrogen content of the residues was of primary importance in influencing mineralization of nitrogen. Water-soluble nitrogen was about twice as effective as the insoluble fraction in affecting nitrogen release.

(2) For mineral nitrogen accumulation to occur in amounts greater than that supplied by the soil, an incorporated residue would have to contain a minimum of approximately 1.66 to 1.89 percent nitrogen content.

(3) A multiple correlation, using information of both total nitrogen and water-soluble nitrogen, was significantly better correlated with the accumulation of mineral nitrogen than when total nitrogen and total carbon, or just total nitrogen alone, was used.

(4) Carbon content of the residues played an insignificant role in the relative release of nitrogen from the different residues.

(5) The simple correlation of total nitrogen in the residue and nitrogen release was significantly better than when the C/N ratio was used as the independent variable. When the ratio was plotted against nitrogen release, a curvilinear regression line was obtained. The dividing line between positive and negative nitrogen release was a ratio of approximately 20:1.

(6) The use of multiple correlation and regression coefficients did not significantly improve the relationship between total nitrogen and total carbon, and the accumulation of mineral nitrogen over the use of total nitrogen alone; it was, however, significantly better than that found when the C/N ratio was used. The added advantage of multiple correlation and regression is that it is a linear function.

(7) In the constant-air-flow method, the information of early CO_2 release seemed to be a better criterion of nitrogen release than total CO_2 or total carbon, as evidenced by a higher R value in the multiple correlation.

U. Ill., Urbana, Ill.

Goring, C. A. I., and Martin, R. T. DIFFUSION AND SORPTION OF AQUA AMMONIA INJECTED INTO SOILS. Soil Sci. 88: 336-341. 1959.

Diffusion and sorption of row-applied aqua ammonia was investigated. Gravity did not influence the diffusion and sorption pattern. The rate of diffusion decreased with decreasing air space, increasing moisture, and decreasing temperature.

The ability of the soil to sorb ammonia was a function of its clay content, organic matter, and type of cation saturation.

The radius of the cylinder of sorption of ammonia could be crudely calculated from the formula

$$R = \sqrt{\frac{C}{3.14A}} + 1$$

where A is the ammonia sorption capacity of the soil in grams of nitrogen per cubic inch, and C the number of grams of nitrogen applied per inch of row.

Agr. Res. Lab., Dow Chemical Co., Seal Beach, Calif.

Walsh, L. M., and Murdock, J. T. NATIVE FIXED AMMONIUM AND FIXATION OF APPLIED AMMONIUM IN SEVERAL WISCONSIN SOILS. Soil Sci. 89: 183-193. 1960.

From preliminary experiments using exfoliated vermiculite it was concluded that a N HF:N HCl mixture effectively removes all fixed ammonium in vermiculite or soil if a solution: clay ratio of 100:1 or a solution: soil ratio of 40:1 is used and the sample is continuously agitated for 24 hours.

Appreciable amounts of native fixed ammonium, 0.5-1.0 me. per 100 g., are found in the solum of most medium- and fine-textured Wisconsin soils. Gray-brown podzolic and brunizem soils do not differ appreciably in their fixed ammonium content.

The surface horizon of most Wisconsin soils will fix small amounts (average of 0.1 me. per 100 g.) of added ammonium under moist conditions. The B horizons of these soils will fix about twice as much ammonium as the A horizon. In most of the soils studied nearly twice as much fixation occurs in frozen as in moist soils. Oven-drying (55°C.) the soil after adding ammonium increases fixation considerably. Nearly all the soils studied fixed over 0.5 me. per 100 g. and a few subsoils fixed over 1.0 me. per 100 g. under oven-dry conditions.

Simple correlations of the various factors investigated in this study suggest: (1) That the nitrogen released by the modified HF procedure for determining fixed ammonium does not originate in the organic fraction of the soil; (2) that exchangeable ammonium released upon drying originates from the organic nitrogen fraction of the soil and not from the native fixed ammonium in the clay minerals; (3) that those soils in the gray-brown podzolic group which contain clay minerals capable of releasing potassium upon drying also contain clay minerals capable of fixing added ammonium under moist, frozen, and oven-dry conditions; and (4) that as the moist exchangeable potassium increases in brunizem soils, fixation of added ammonium under moist, frozen, and oven-dry conditions decreases, presumably because the fixing sites are satisfied with potassium.

U. Wisc., Madison, Wisc.

Simpson, J. R. THE MECHANISM OF SURFACE NITRATE ACCUMULATION ON A BARE FALLOW SOIL IN UGANDA. J. Soil Sci. 11: 45-60. 1960.

In a red latosal loam under bare fallow at Kawanda, Uganda, nitrate accumulates to as much as 70 p.p.m. nitrate nitrogen during short periods of dry weather. Nitrate accumulation appears to be a microbiological process involving nitrifying bacteria similar to Nitrosomonas and Nitrobacter. Nitrate accumulation in an isolated topsoil, 3 in. deep, ceased when the moisture content fell below 10 percent. Accumulation continued on plots which were in contact with the subsoil and which remained at 10 percent moisture.

It was concluded that under the conditions of these experiments, transport of ions to the surface by capillary transport or diffusion does occur, but is not responsible for the major nitrate accumulation, which seems to depend on progressive drying of the topsoil during which nitrate, as formed, becomes protected by the dry conditions from microbial reduction, assimilation, and leaching. Any process which prevents the progressive drying, e.g., shading, mulching, and watering, can be expected to favor nitrate removal and so to prevent nitrate accumulation.

Commonwealth Sci. and Indus. Res. Organ., Canberra, Australia.

Toth, S. J. USING ORGANIC WASTES IN AGRICULTURE. Compost Sci. 1(1): 10-14. 1960.

Research shows that even highly industrialized states have enough organic waste materials available to spread one ton of organic matter per acre on all cultivated land. The author suggests formation of research groups, sponsored by industries with waste disposal problems, to study the use of residues for agricultural purposes.

A Table of the chemical composition of various organic wastes is presented.

Rutgers U., New Brunswick, N.J.

Salinity and Alkali Problems

Hulsbos, W. C., and Boumans, J. H. LEACHING OF SALINE SOILS IN IRAQ. Netherlands J. Agr. Sci. 8: 1-10. 1960.

A large proportion of the soils of the Lower Mesopotamian Plain are very saline.

Some data are presented on the salt movement in the top-soil and the overall discharge of salt from the area. It is concluded that, even with intensive drainage and leaching operations, the sub-soil water and the drain water will remain salty for a very long period.

A leaching curve has been constructed on the basis of field experiments on the Dujailah Experimental Farm. The curve has been compared with a curve for Annanah soils and a curve for a Utah soil. The limits and the use of the curve are explained. With the aid of this leaching curve and the data on the salinity before leaching, the amount of water needed to obtain any required salinity level in the soil can be calculated. To facilitate the calculations, a leaching graph has been constructed to show the drain-water depth per unit depth of soil as a function of the salinity before leaching and of three different levels after leaching.

It is pointed out that the information on the amount of water required for leaching has to be considered and used in conjunction with agricultural information on the salt-tolerance of field crops and need for fertilizers, to obtain a general leaching plan for the reclamation of a given area.

No address given.

Pearson, G. A., and Bernstein, L. SALINITY EFFECTS AT SEVERAL GROWTH STAGES OF RICE. Agron. J. 51: 654-657. 1959.

The effect of soil salinity at three stages of development on the growth of Caloro rice has been investigated in the greenhouse maintaining careful control of the rate of percolation and the conductivity of the irrigation water. The results indicate that salinity inhibited growth more severely at earlier stages of growth than at later stages. Even when based on equal weighted-mean conductivities, salinity during the tillering stage inhibited growth twice as much as during heading. The relationship between growth and salinity can be closely expressed by a multiple regression equation relating growth to salinity during tillering, heading, and maturation stages.

U. S. Salinity Lab., SWCRD, ARS, USDA, Riverside, Calif.

Cover Crops

Flocker, W. J. WINTER COVER CROPS HELP FIGHT SOIL COMPACTION. Crops and Soils 12(1): 17-18. 1959.

Winter cover crops may be an answer to soil compaction problems in the California area. Over 2 million acres of farm land in the State are already compacted to the point where yields are reduced and tillage costs increased. Another 2 to 3 million acres are rapidly approaching this condition.

Cover crops withdraw moisture from the lower regions of the soil, reducing subsoil's tendency to pack. They also add organic matter to the soil and reduce water runoff and soil erosion.

Moisture content of the soil is the most important factor influencing soil compaction. In vegetable-growing areas, where 2 or 3 successive crops are grown under irrigation in one season, considerable moisture may remain in the lower depths of the soil when tillage is performed. Often this soil moisture content is still well above the "safe level" necessary for preventing compaction. The same is frequently true for early-spring tillage in grain-producing areas.

Soil compaction reduces the size of pore spaces, or openings in the soil, changing their shape and arrangement. It usually gives reduced rates of water intake, less air and gas movement in the soil, and reduced crop yields through root obstruction.

Compaction may develop (to some degree) in all agricultural soils, even sandy soils, either by natural pressures or those created by man and animal. The poor physical condition of compacted soils often results in reduced crop yields and quality, and in higher tillage costs.

There is no way that a farmer can economically alter the texture of his soil. A good soil management program is the only practical answer to soil compaction.

In general, using a winter green-manure crop, especially a sod grass, can play a beneficial role in most California farming operations. It is economical to plant, requires a minimum of tillage, and needs little or no irrigation water once established. It also permits earlier use of the land in the spring by removing the excess soil moisture.

Such cover crops do not interfere with the cash crop, since they are grown during the off season. And, they do add active organic matter to the soil.

The winter cover should be planted as early in the fall as possible, so as to allow the crop to become well established before cold weather.

U. Calif., Davis, Calif.

Henson, P. R., and Hollowell, E. A. WINTER ANNUAL LEGUMES FOR THE SOUTH. U.S.D.A. Farm. B. 2146, 24 pp. 1960.

Crimson clover, vetches, lupines, and other winter annual legumes are grown in most of the South. The plants grow during fall, winter, and spring months. They blossom and set seed in the spring and die when the seed matures. Seeds germinate in the fall.

Winter annual legumes vary in fertility requirements, winter hardiness, palatability, and soil adaptation, and in the amount of seed and forage produced. The choice of a species to grow depends on local soil and climatic conditions and on the use to be made of the crop.

Optimum temperatures for rapid growth of winter annual legumes are different for different crops, and range from about 65° to 80° F. Rate of growth declines as the temperature drops. If the temperature is much below 40°, little or no growth occurs. Unseasonably cold weather may kill the plants, especially if it comes while the plants are making rapid growth. Few species are adapted to the colder parts of the region.

This culture and care bulletin on winter annual legumes describes the various types of the following groups: (1) Annual medics; (2) annual sweetclovers; (3) lupines; (4) roughpea; (5) Serradella; (6) Tangier pea; (7) true clovers; (8) vetches; and (9) winter field peas.

ARS, USDA, Inform. Div., Washington 25, D.C.

Hausenbuiller, R. L., and Clore, W. J. THE USE OF GREEN MANURES AND COVER CROPS IN NUTRITION CONTROL IN CENTRAL WASHINGTON VINEYARDS. Wash. State Hort. Assoc. Proc. 55 Annual Meeting, pp. 122-126. 1960.

The level of available nitrogen in soils of the central Washington area normally is inadequate for satisfactory growth of grapes. An inadequate supply of available nitrogen will result in low vine vigor and reduced fruit production and may be overcome through use of fertilizers or green manure crops. Vetch is recommended as a suitable green manure crop, and the influence it has on vineyard-soil properties is described.

Excesses of nitrogen may occur on occasion in vineyard soils. Nitrogen excesses are undesirable because they promote late season vegetative growth and delay the maturation of fruit and vines. Where this problem exists, the use of a non-legume cover crop, to compete with the grape plant for nitrogen in the later part of the growing season, is suggested.

Most central Washington soils usually supply adequate quantities of phosphorus and potassium in grapes. Where vetch is grown as a green manure crop, fertilization with these nutrients may be necessary to assure maximum growth and accumulation of nitrogen by the vetch plant. The need for phosphorus and potassium may be determined most readily through use of reliable soil tests.

Wash. Irrig. Expt. Sta., Prosser, Wash.

Ahlson, C. B. COVER-CROP MULCHING IN ORCHARDS. J. Soil and Water Conserv. 14: 224-225. 1959.

The use of organic matter and the right method of tillage are important in orchard management. Sources of organic matter may include seeded or volunteer cover crops, plant residues, orchard prunings, straw, old hay, sawdust shavings or chips, and manures. Annual cover crops are a large source of soil organic matter.

Good orchard management requires early seeding of cover crops--preferably before October 15 in California. A heavy volunteer or seeded cover crop is helpful. Cereals and legumes are used, including barley, oats, rye, vetch, horse beans, Bell beans, field peas, and bitter clover. Mustard and mallow are also good. Fertilizer applications may be needed.

California orchardists, who have cut down on cultivating, are convinced that excessive tillage is detrimental and an unwarranted expense. Resourceful orchardists are developing mulching systems to improve soil and water management. Protection of soil surface, improvement of soil structure and fertility, and water intake are some of the fundamental practices now being considered by the more progressive orchardists.

SCS, USDA, Watsonville, Calif. (Now retired.)

Climatic Influences

Jung, G. A., and Smith, D. INFLUENCE OF SOIL POTASSIUM AND PHOSPHORUS CONTENT ON THE COLD RESISTANCE OF ALFALFA. Agron. J. 51: 585-587. 1959.

Buffalo alfalfa grown in sand cultures under different levels of K and P was subjected to freezing temperatures in early December after hardening out-of-doors at Madison, Wisconsin.

The percent of plant survival and the amount of topgrowth production after exposure to freezing temperatures increase as the level of elemental K was increased to an amount equivalent to 200 pounds per acre in the pots and then decreased at the higher levels when elemental P was held constant at an amount equivalent to 80 pounds per acre. A similar response was obtained with increasing rates of elemental P with the maximum percent of plant survival and topgrowth production occurring at 40 or 80 pounds per acre when elemental K was held constant at an amount equivalent to 200 pounds per acre.

The percent of plant survival and topgrowth production following exposure to freezing temperatures was found to be fairly constant when the plants were grown under increasing levels of K and P provided that the amounts of the 2 elements present were held at a ratio of 5 to 2, respectively. Although further work is needed to test these conclusions, the results do suggest that an optimum ratio may exist between K and P insofar as the cold resistance of alfalfa is concerned.

Wisc. Agr. Expt. Sta., Madison, Wisc.

Bleak, A. T. GERMINATIVE CHARACTERISTICS OF GRASS SEED UNDER SNOW. J. Range Mangt. 12: 298-302. 1959.

Moistened seeds of smooth brome, Tualatin oatgrass, and tall oatgrass and pregerminated seeds of smooth brome developed visible radicles or shoots in thawed soil under a deep snow cover. Seeds in small cloth bags placed under one-half inch of soil and a permanent winter snow cover on November 30, 1956, and January 4, 1957, were removed at monthly intervals. Snow depth varied from 14 inches in November to 90 inches in April. By May 13, when the snow cover was still 46 inches deep, some seeds of smooth brome and tall oatgrass had developed primary roots over 1-1/2 inches long and shoots were just emerging from the soil surface. Viability of pregerminated seeds of smooth brome and Tualatin oatgrass decreased substantially more than seeds of the comparable control lots. Percent decrease in viability under the deep snow cover was greatest in the old seed of Tualatin oatgrass with low initial viability.

Additional observations on conditions at or near the soil surface were made in pits dug in the deep snow to plant and remove seed. Frozen soil present in the fall and early winter began thawing in February. In March, April, and May the soil at a depth of one-half inch was moist and frost-free. Decomposition of cotton bags, fine leaves and stems, and other organic material by fungi and other organisms was rather rapid in the moist frost-free soil under the deep snow. Growth of established perennial grasses under the snow cover was observed in the pit dug in March and all pits dug later.

CRD, ARS, USDA, Ephraim, Utah.

Frischknecht, N. C. EFFECT OF PRESOWING VERNALIZATION ON SURVIVAL AND DEVELOPMENT OF SEVERAL GRASSES. J. Range Mangt. 12: 280-286. 1959.

Fall planting or storage of soaked seed in a snowbank or refrigerator prior to spring planting accomplishes vernalization of some perennial grasses, notably intermediate wheatgrass and mountain rye. Other grasses used in this study, with the possible exception of Russian wildrye, are capable of first-year flowering from spring plantings without cold treatment. A high percentage of plants flowered when seeds had been treated prior to spring planting; to what extent a few days' earlier emergence from treated seeds was a contributing factor is not known. The other species investigated were four wheatgrasses--pubescent, tall, crested, and fairway--and Indian ricegrass and Great Basin wildrye.

Whereas both snowbank and refrigerator storage effectively vernalized seeds, snowbank storage was advantageous in that it required no special equipment and seeds did not dry during the process. Use of plastic bags instead of cloth bags in the refrigerator lessened the problem of seeds' drying.

These cold treatments hastened emergence from spring planting and aided survival on dry sites. With such treatment spring plantings compared favorably with fall plantings.

This study suggests that use of vernalized seed in spring planting of some range grasses may help obtain successful stands when fall planting has not been feasible. Also, this procedure might produce a crop of seed from spring plantings a year earlier than otherwise or increase seed yield the following year, at least in certain species.

Intermountain Forest and Range Expt. Sta., FS, USDA, Ogden, Utah.

Aderikhin, P. G., and Tikhova, Y. P. COLOR CHANGES OF NORTHERN SURFACE SOILS. Soviet Soil Sci. 10: 1142-1147. Oct. 1958.

Experiments were conducted on experimental plots of the Kola Branch of the USSR Academy of Sciences. Darkening soils was accomplished by applying carbon black (2.23 tons per acre) or powdered peat (2.23 tons per acre). Soot and peat were applied to soil in a thin layer. Powdered chalk (2.23 tons per acre) was used to give a white color to the soil surface. Individual plots were fertilized.

The authors conclude their work as follows: (1) Soils, given a dark color, absorb more solar heat and warm up better than do soils with a light grey natural color. This is true in both clear and cloudy weather. (2) When soils are given a dark color there is an intensification of the processes of mobilization of nutritive substances in the soil content of nitrates, ammonium, available phosphorus, and available potassium. (3) When the thermal and nutritional regime of the soils was improved, the oats developed better on the plots with a dark color than on the non-colored plots. (4) The plant intake of nutritive substances from the soil, takes place more intensively on dark colored plots than on the non-colored plots. And (5) the problem of coloring soils can be of very great importance for agriculture in the north.

Amer. Inst. Biol. Sci, 2000 P St. N. W., Washington 6, D. C.

Isleib, D. R., and Thompson, N. R. THE INFLUENCE OF TEMPERATURE ON THE RATE OF ROOT AND SPROUT GROWTH OF POTATOES. Amer. Potato J. 36: 173-178. 1959.

Sprout and root growth of potato seed pieces representing ten varieties was studied in the range of 45-60° F. The critical temperature for growth was in the 48-50° range. No consistent association between early maturity and rapid seed-piece germination could be determined.

Excellent sprouting and reasonable root growth did occur at 50°, so that a critical growth temperature for potato seed pieces of 50° F. is proposed.

Mich. State U., East Lansing, Mich.

Sakai, H. EFFECT OF TEMPERATURE ON NITRIFICATION IN SOILS. Soil and Plant Food 4(4): 159-162. 1959.

Nitrification must be treated as the phenomenon comprising two parts. The one is the nitrate forming ability from ammonia by a unit cell, and the other is the process of increasing the number of nitrifying organisms.

The effect of temperature on each part of nitrification by using the "washing cultivation method" was examined. As samples, use was made of three kinds of soils each of which has different characteristics in respect to nitrification activity. These were alluvial soil which has high nitrifying power, volcanic ash soil which has low power, and river-side sand which is the most feeble. The results obtained can be summarized as follows: (1) In alluvial soil, nitrifying ability reached the maximum limit most quickly at 25° C as well as 15° C. At 5° and 35° C, nitrification was fairly delayed, but nitrate formation was rather great. In volcanic ash soil with low nitrifying ability nitrification was more delayed within the temperature range apart from the optimum. In river-side sand, nitrifying ability did not show any increaseat 5° and 35° C. (2) Soils which got high nitrifying ability at 25°C appeared to show less nitrate formation at other temperatures than the soils which were cultivated at the same temperature from the beginning of incubation. However, more nitrate was formed at 5° C in volcanic ash soil and sand by cultivating at 25° C for the purpose of increasing the number of microbes. And (3) from these results it is clarified that nitrification is much influenced at low temperature by the number of microbes in soils and cultural conditions, especially temperature. These exert much influence upon the increasing process of nitrifying organisms.

Hokkaido Nat'l. Agr. Expt. Sta., Sapporo, Japan.

Denmead, O. T., and Shaw, R. H. EVAPOTRANSPIRATION IN RELATION TO THE DEVELOPMENT OF THE CORN CROP. Agron. J. 51: 725-726. 1959.

A study was undertaken to determine the period during the growing season of an annual row crop (corn) when current procedures for estimating evapotranspiration from meteorological elements might be applied successfully.

The ratio of measured evapotranspiration from corn to open pan evaporation was calculated at different periods of the growing season.

It was found that prior to silking the ratio increased in a sigmoid manner from a value of 0.36 at the planting date to 0.81 at silking. The value of 0.81 remained constant for 16 days after silking and then declined, at first gradually, then rapidly. It is suggested that the changing ratio is due to increasing leaf area until silking and to declining physiological activity of the crop soon after the commencement of ear growth.

These data indicate that the corn crop in Iowa approaches the condition of a green crop, actively growing and completely shading the ground for a period of only 2 to 3 weeks during its growing season. Since the requirements of active growth and complete shading of the ground are necessary restrictions in using current procedures for estimation of evapotranspiration, it is considered that such procedures will be applicable to corn only during this short period.

Iowa State U., Ames, Iowa.

Army, T. J., Bond, J. J., and Van Doren, C. E. PRECIPITATION-YIELD RELATIONSHIPS IN DRYLAND WHEAT PRODUCTION ON MEDIUM TO FINE TEXTURED SOILS OF THE SOUTHERN HIGH PLAINS. Agron. J. 51: 721-724. 1959.

Winter wheat yields from three commonly employed cropping sequences in the Southern High Plains were evaluated in relation to long term weather records. In experiments conducted on Pullman silty clay loam, grain yields with continuous cropping, alternate wheat-fallow, and in a wheat-sorghum-fallow rotation were found to be significantly related to growing season (October-through-June) precipitation. Coefficients of determination showed that 55 to 66% of the variability in wheat yields was attributable to variability in growing season precipitation.

Cumulative probability estimates of October-through-June precipitation were used to establish yield level probabilities for each cropping sequence. With alternate wheat-fallow or in a wheat-sorghum-fallow cropping sequence more than 10 bushels of grain per acre can be expected 80% of the time. Continuous cropping can be expected to produce more than 10 bushels of grain only 50% of the time. Other calculated yield level probabilities similarly suggested that the use of a fallow system for dryland wheat production on the Southern High Plains would materially reduce the frequency of crop failures and add stability to farming operations.

Straw production, a major deterrent to wind erosion, was considerably greater with the use of a fallow system than with continuous cropping.

SWCRD, ARS, USDA, Fort Collins, Colo.

Wolcott, A. R., and Ellis, N. K. INTERNAL BROWNING OF POTATO TUBERS: VARIETAL SUSCEPTIBILITY AS RELATED TO WEATHER AND CULTURAL PRACTICES. Amer. Potato J. 36: 394-403. 1959.

Internal browning injury to potato tubers was more severe in varieties grown in 1954 under conditions of artifically maintained moisture supply than under drought conditions in 1953.

Necrotic symptoms were first observed during, or just after, periods of rising temperature, or of an improved moisture situation following periods of low temperature, or drought. Severe internal browning developed concurrently with extensive resorption of tubers during periods of fluctuating temperatures under the shortening day-lengths of September. These results may be interpreted in terms of known photoperiod responses of the potato plant, as modified by genetic constitution, temperature, moisture, and nutrition.

The distribution of internal brownspot, heart necrosis, corky ringspot, and canker type internal rust spot among varieties and among plantings made on different dates, supports the view that these different patterns of necrosis have a common physiological origin but vary in form and severity with differences in the developmental age of tuber tissues at the time of injury.

Purdue U., Lafayette, Ind. (Jr. Author)

McGinnies, W. J. EFFECTS OF MOISTURE STRESS AND TEMPERATURE ON GERMINATION OF SIX RANGE GRASSES. Agron. J. 52: 159-162. 1960.

Crested, intermediate, pubescent, and beardless wheatgrasses; smooth brome, and Russian wildrye were germinated under moisture stresses of 1/3, 5, 7 1/2, 10, 12 1/2, and 15 atmospheres of osmotic pressure at 10°, 20°, and 30° C. Moisture stress and temperature had an influence on germination. As moisture stress increased, germination was delayed, the rate of germination was reduced, and total germination after 28 days was lower. The highest average germination for all species was at 20°, indicating that this was near the optimum temperature for these species. There is a strong interaction between temperature and moisture stress, and all species are able to germinate better under high moisture stress at 20° than at the 10° or 30°. Seed size showed a positive correlation with germination at the 15-atmosphere level of moisture stress.

It is suggested that more attention be given to temperature in designing methods for seeding grasses under range conditions.

CRD, ARS, USDA, Fort Collins, Colo.

Kushman, L. J., Hoover, M. W., and Haynes, F. L. THE EFFECT OF WET SOIL AND CARBON DIOXIDE ON POTATO CHIP COLOR AND SUGAR CONTENT. Amer. Potato J. 36: 450-456. 1959.

The data indicate that high soil moisture caused changes in potatoes which influenced the color of chips made from them. The poor color of chips made from potatoes grown under high soil moisture was always apparent after storage at 60° F. and sometimes also immediately after harvest. The effect of high soil moisture levels on chip color may have been due to the accumulation of carbon dioxide in the tubers, as holding potatoes in an atmosphere of carbon dioxide produced similar effects on chip color.

The reducing sugar and sucrose contents immediately after treatment with gas mixtures were not indicative of the changes that occurred after treatment.

The importance of maintaining sufficient moisture for good growth and high yields is obvious. Potatoes that have been subjected to excessively wet soil conditions before harvesting may produce poorly colored chips However, in order to better understand the effects and relationships between soil moisture conditions and chip color, more data are needed. Through selection of soil type and provision for drainage some measure of control over soil moisture is possible even in periods of heavy rainfall. In recent years irrigation of potato fields has increased. More care may be needed to prevent over-irrigation prior to harvesting potatoes intended for chip manufacturers.

AMS, USDA, Raleigh, N. C.

Humphrey, R. R. FORAGE AND WATER. J. Range Mangt. 12: 164-169. 1959.

In a talk on the subject of forage and water the author gives the following conclusions for forage production on range and forests.

Water Use: Water use varies approximately in proportion to (1) Length of time a plant is actively growing or is producing a crop of green leaves; (2) depth and extent of the root system; and (3) amount of water available. Thus, trees generally use more water than shrubs; shrubs than grasses; and grasses than forbs.

Water efficiency, or dry matter produced per unit of water consumed, is a highly variable figure and one about which little is known. It is highly possible that efficiency for a given species under moisture stress may be quite dissimilar from a figure for the same species where moisture is not deficient. Desert trees appear to be less efficient than associated perennial grasses. Spring flow may be increased by removal of trees and shrubs from a watershed when the spring flow originates on the treated watershed.

Interception: Large amounts of precipitation may be intercepted by vegetation, these amounts being roughly proportional to denseness and volume of the plant cover. Grass intercepts little precipitation in comparison with trees and shrubs.

Runoff and Sedimentation: Runoff and sedimentation are in rather direct proportion to forage plant density or ground cover. A dense stand of brush or trees that intercepts appreciable amounts of precipitation, although not necessarily contributing much in the way of forage, may be highly effective in reducing runoff and erosion.

U. Ariz., Tucson, Ariz.

Weldon, L. W., Bohmont, D. W., and Alley, H. P. THE INTERRELATION OF THREE ENVIRONMENTAL FACTORS AFFECTING GERMINATION OF SAGEBRUSH SEED. J. Range Mangt. 12: 236-238. 1959.

Effects of light, temperature, and available moisture upon the germination of sagebrush seed were studied. The three environmental factors were combined at two levels each for light and temperature and three levels of available moisture giving a total of 12 different conditions tested. The following conclusions can be drawn: (1) Sagebrush seed exposed to light gave germination percentages three times as high as sagebrush seed germinated in the dark; (2) sagebrush seed subjected to a temperature of 70° F. resulted in a germination percentage double that obtained when sagebrush seed was subjected to a temperature of 38° F., (3) a reduction in available moisture substantially reduced the germination of sagebrush seed; (4) a temperature of 70° F. lessened the effect of darkness and low available moisture in reducing the germination of sagebrush seed; and (5) germination was highest at 70° F., with free moisture and full light.

CRD, ARS, USDA, Laramie, Wyoming.

Burton, G. W., Jackson, J. E., and Knox, F. E. THE INFLUENCE OF LIGHT REDUCTION UPON THE PRODUCTION, PRESISTENCE AND CHEMICAL COMPOSITION OF COASTAL BERMUDAGRASS, (CYNODON DACTYLON). Agron. J. 51: 537-542. 1959.

Three degrees of shade--approximately 64%, 43%, and 29% of normal at mid-day--were applied to Coastal bermudagrass fertilized with 200 and 1,600 pounds of nitrogen per acre per year in 1956 and 1957. A new test area was used in 1957. The following results represent the average effect of one season of shade:

1. Forage yields decreased as shade increased, the rate being much faster at the high-nitrogen level. High-nitrogen plots yielded significantly more than low-nitrogen plots without shade and significantly less with maximum shade.
2. Except in the third harvest following a cloudy, rainy period, low-nitrogen plots receiving the least shade yielded as well as the no-shade plots.
3. Root and rhizome yields at the end of the season decreased as shade increased, there being less than half as much yield under the heaviest shade.
4. Below-ground reserves were decreased as shade increased, giving indexes of 2.2, 1.6, 0.8, and 0.1 for 0, 1, 2, and 3 layers of shade cloth respectively.
5. Relative annual dry-matter yields of 100.0, 68.2, 42.1, and 29.8 were obtained from high-nitrogen plots receiving 100% and approximately 64, 43, and 29%, respectively, of normal light at mid-day, suggesting that light may have set the ceiling for yield.
6. At the low-nitrogen level, increased shade increased the moisture content of green grass and the lignin, crude protein, true protein, phosphorus, calcium, and magnesium percentages of the dry matter, had no effect on cellulose, and decreased available carbohydrates to 57.6% of normal under maximum shade.
7. At the high-nitrogen rate, increased shade had comparatively little effect upon the composition of the grass except to increase the phosphorus content and decrease the available carbohydrates to 76.2% of normal under maximum shade.
8. High-nitrogen fertilization increased the protein fractions and phosphorus content of the forage, reduced the calcium and magnesium percentages slightly and cut the total available carbohydrates from 12.4% for all low-nitrogen forage to 7.4% for comparable high-nitrogen grass.

CRD, ARS, USDA, Tipton, Ga.

Surface Soil Removal

Nelson, J. L., and Crawford, C. L. FERTILIZER NEEDS OF LEVELED LAND IN THE COLUMBIA BASIN. Wash. Agr. Expt. Sta., Sta. C. 368, 4 pp. 1960.

Development of a typical Columbia Basin Project farm unit includes extensive land leveling in preparation for irrigation. Approximately 90 percent of the irrigable land in the Basin is surface irrigated. Most of this land must be leveled to some degree. "Cuts" and "fills" of three to four feet are not uncommon. After leveling, the land usually irrigates well, but often little or nothing will grow on the severely cut areas for several years.

From 5 to 50 percent of a farm unit may be affected by poor crop growth because of leveling. Most serious effects are usually found where more than a foot of soil has been removed or where a fill of more than a foot has been made with subsoil from the second foot or deeper.

These areas present difficult problems in establishing experimental plots because of their small size, irregular shape, and great variability. However, some field experiments have been completed and a large number of soil samples have been taken at varying depths for soil tests. The available information described in this circular may be of use to farmers and agricultural workers even though the research is incomplete.

The authors summarize the work as follows:

1. NITROGEN--None of the virgin soils of the Columbia Basin furnishes more than about 40 pounds of N per acre per year to field crops. Thus most of the N required by the crop (except legumes) must be applied as fertilizer. The nitrogen furnished to crops by subsoils may be slightly less than by surface soils.

2. PHOSPHORUS--Available phosphorus can be expected to be very low on deep cuts. This can be determined quite well with a soil test, taking separate samples from cuts and noncuts. Applications of phosphorus of 100 to 250 pounds P_2O_5 per acre may be required on heavy cuts to overcome the deficiency. This sometimes can be accomplished by going over the whole field once with a normal fertilizer setting, going over the fills and light cuts twice, and the heavy cuts three times. These cut areas in the field can be located by leveling maps or by crop appearance after the first year.
3. POTASH--A soil test is the best guide to possible potash deficiencies on cut areas. Where the soil test indicates a need for potash for such crops as potatoes and vegetable crops, 50 to 100 pounds of K_2O per acre will probably suffice.
4. ZINC--Most of the soils in the Columbia Basin increase in lime with depth. Since lime makes soil zinc less available, almost all subsoils will be zinc deficient for susceptible crops such as beans, onions, potatoes, and corn. An application of 10 pounds of actual zinc per acre, plowed under, should correct the deficiency from 3 to 5 years.
5. OTHER MINOR ELEMENTS--All other essential nutrients have been applied without effect on cut areas. Any deficiencies that may be found will probably be relatively unimportant.
6. No amount of fertilizer can correct cut area problems where cuts are made very close to, or into, coarse sand, gravel, caliche, or rock. The usual major problem in these cases is to keep the scalped spots from drying out. Lighter but more frequent irrigations sometimes help. Wherever sufficient soil is left for normal root growth, the fertilizer treatments recommended above should go a long way toward obtaining normal plant growth on cut areas.

SWCRD, ARS, USDA and Wash. State Agr. Expt. Sta., Inst. Agr. Sci., Wash. State U., Pullman, Wash.

Mulching

White, A. W., Jr., Giddens, J. E., and Morris, H. D. THE EFFECT OF SAWDUST ON CROP GROWTH AND PHYSICAL AND BIOLOGICAL PROPERTIES OF CECIL SOIL. Soil Sci. Soc. Amer. Proc. 23: 365-368. 1959.

A field experiment was conducted over a 3-year period from 1954 through 1956 to determine the effect of pine sawdust on crop growth and soil properties. Corn was grown all 3 years of the experiment and tomatoes and lima beans for 2 years.

Sawdust incorporated with the soil had no beneficial effect on plant growth. However, when sawdust was applied as a mulch, crop yields were increased markedly with the exception of corn in 1954, an extremely dry year. Higher yields of crops on mulched soils apparently resulted from an increase in available water supply and a reduction in soil temperature as compared to the unmulched plots. A nitrogen variable included in the corn investigation revealed that high N application was required to obtain increased corn yields from sawdust mulch. Sawdust, applied either as a mulch or mixed with the soil, decreased the nitrate content of the soil. The soil microbial population was not influenced by the mulch but was increased by incorporating sawdust with the soil.

U. of Ga., Athens, Ga.

van Wijk, W. R., Larson, W. E., and Burrows, W. C. SOIL TEMPERATURE AND THE EARLY GROWTH OF CORN FROM MULCHED AND UNMULCHED SOIL. Soil Sci. Soc. Amer. Proc. 23: 428-434. 1959.

On corn plots in Iowa, South Carolina, Ohio, and Minnesota which were treated with oat straw either plowed under or on the surface and with two levels of N, measurements were made of soil temperature at the 4-inch depth, and these measurements were correlated with dry matter yields of corn early in the season. The data from Iowa, Minnesota, and Ohio support a theory that early season corn growth is decreased by low temperatures caused by a mulch of crop residues. The data from South Carolina, where soil temperatures were considerably higher than in the three other states, showed that the mulch did not appreciably influence the growth rates. The data from all four of the states agreed in a general way with data of Lehenbauer who found that for a range of temperatures from about 50° to 86° F. there is an increase with temperature of seedling growth rate; whereas around 86° to 90° F. there is little influence; and from about 90° to 111° F. there is a decrease. From the soil temperature measurements taken at a 4-inch depth it was shown how temperatures for other depths could be deduced from a theoretical expression based on heat flow theory. A detailed example of the use of the heat flow theory in studying the mulch problem in practical experimentation is presented.

The data from Iowa show that not all of the differences in corn growth between mulched and unmulched soil can be accounted for by differences in soil temperature. In data not given from the four experiments reported herein, it was found that the mulch treatments also influenced the soil moisture content and K and N uptake by plants on some of the experiments at certain times during the growing season. This points out that mulches can influence plant growth in a number of ways. The relative importance of these factors to plant growth will probably depend on soil and climatic conditions.

J. Paper J-3601 of the Iowa Agr. and Home Econ. Expt. Sta., Ames, Iowa.

Clarkson, V. A. EFFECT OF BLACK POLYETHYLENE MULCH ON SOIL AND MICROCLIMATE TEMPERATURE AND NITRATE LEVEL. Agron. J. 52: 307-309. 1960.

Soil temperatures and nitrate nitrogen levels in soils mulched with black polyethylene plastic were compared to those in nonmulched areas. Soil temperature studies were made in 1957, 1958, and 1959, using 1-1/2 mil, 4-feet-wide, black polyethylene plastic as a mulch. Four-pen recording thermographs were used to record temperatures.

The temperature range of soils at 1-, 3-, and 6-inch depths was affected by the use of a plastic mulch. Although the maximum temperature recorded at the various depths was somewhat higher when mulched, these temperatures were not harmful to plant growth. Minimum soil temperatures under a plastic mulch were also higher than on comparative check areas. Temperatures were 20° to 25° F. higher at the surface of the mulch and at 2 inches above the mulch than at corresponding nonmulched locations.

A study of the movement, leaching, and utilization of nitrate nitrogen under a polyethylene mulch showed decisively that the rate of movement and leaching was reduced. Corn planted in these tests indicated that utilization of applied nitrogen was better where a mulch was used.

Union Carbide Plastics Co., Res. Farm., Clayton, N. C.

Slater, C. S., and Broach, R. V. D. PLASTIC GROUND COVERS AND WHAT THEY DO. Crops and Soils 12(6): 12-13. 1960.

Plastic materials offer the grower new opportunities for improving light, temperature, moisture, and soil-tilth conditions in his field or garden.

When used as ground covers, plastics have several advantages. These include: (1) Warming soils; (2) controlling weeds; (3) reducing evaporation; (4) keeping surface soil moist for seed germination; and (5) controlling erosion during cover establishment.

Black plastic exposed to full sunlight can get mighty hot--150° F. or more--on a hot summer day. How warm the soil gets depends on the temperature of the sheeting and the contact between it and the soil. When there is good contact--as when the plastic lays flat over smooth soil--much of the heat is transferred to the soil. If the black plastic cover is supported above the ground, with an insulating air layer beneath, the surface soil may be only a little warmer than similar soil exposed to direct sunlight. If a reflective-type sheeting--such as metallic plastic, white plastic, or aluminum foil--is used it may be cooler.

Soil temperatures are usually highest under a cover of clear plastic. In this case, most of the solar energy is transmitted through the film and absorbed by the soil. The color of the soil then determines how much heat is built up--a dark-colored soil getting hotter than a light-colored one. The temperatures of the cover and the air under it are determined by the heat generated in the soil rather than by direct absorption of sunlight. Unlike black plastic, the contact of clear plastic with the soil or the lack of it has little effect on soil temperature.

To keep soils cool, select a cover with high reflection and low transmission of light. Aluminum foil best meets this requirement; but white partially-opaque plastic is a close second. The white plastic allowed about 25 percent of the light received to pass through. Both types of cover, if kept clean, will keep the surface soil cooler than exposed soil.

How much light will pass through is an important factor in selecting a sheeting for ground-cover use. In terms of foot candles of light transmitted through the covers (from a 1,000 foot candle source), the plastic materials are ranked as follows: black, zero; metallic, 30; white, 250; and clear, 920. Nonplastic covers--on the same basis would also vary widely; aluminum foil, zero; white cloth, 700; and window glass, 900.

Whenever a cover is needed to control weed growth, black plastic is a good choice. But if you want to grow something under the plastic, a certain amount of light must pass through. Thus, clear plastic is used to cover cold frames and hotbeds. White plastic can be used similarly, and is even more suitable as the weather gets warmer.

Care must be taken with clear plastic, as with the more common glass sash, to prevent the build-up of damaging and sometimes even lethal temperatures on unseasonably warm sunny days.

Metallic plastic lets so little light through that it holds back the germination and growth of many broadleaf weeds and crabgrass. But it allows the near-normal development of other common grass seedlings.

Plastics or similar films used as a ground cover will prevent water from evaporating from the soil surface. A dry surface soil tends to become moist when covered because water vapor from down in the soil condenses on the film and drips back on to the soil. This self-irrigating feature is important for germination of shallow-planted seeds--such as the grasses--on sites where irrigation is not possible. Even if the surface soil is too dry when the cover is laid, moisture for germination and growth will collect from condensed vapor when nights are cool--provided that the deeper soil is well supplied with moisture.

Air under plastic ground covers stays moist; in fact, it will be close to 100 percent relative humidity.

Erosion control is another advantage of plastic ground covers, especially where grass has to be established on sloping areas such as newly-formed roadsides or water spillways.

Seedings on clay soils, which are puddled by rain and then bake and crack on drying, are also benefited by a ground cover of sheet plastic. Once the clayey soil is put in a satisfactory seedbed condition by tillage, it will keep its tilth under a plastic ground cover.

SWCRD, ARS, USDA, Beltsville, Md.

PLANT MANAGEMENT

Pasture and Haylands

Blackmore, L. W. CHEMICAL PASTURE ESTABLISHMENT ON STEEP HILL COUNTRY. New Zealand J. Agr. 100: 125-131. 1960.

The establishment of new pasture (perennial ryegrass, cocksfoot, and clovers) on a 6-acre block of steep hill country by chemical treatment (dalapon and amitrol) to kill existing turf for sowing and fertilizing of the area, all done by aircraft are described in this article.

The outstanding improvement in the pasture and the raising of the carrying capacity from two to six ewes per acre show that under ideal conditions of aspect, climate, and management the method of chemical pasture establishment will work.

Farm. Advisory Officer, Dept. Agr., Dannevirke, New Zealand.

Hull, A. C., Jr. PELLET SEEDING OF WHEATGRASSES ON SOUTHERN IDAHO RANGELANDS. J. Range Mangt. 12: 155-163. 1959.

Two lots of unpelleted crested wheatgrass seed, one lot of unpelleted intermediate wheatgrass seed, and four lots of coated seed pellets made from these seeds were tested in the laboratory and in the field. Tests in a germinator and in the greenhouse showed that coating probably did not effect the germination percentage of this seed.

The seven lots of seed and pellets were seeded in November 1954 at eight range locations in southern Idaho. First-year results showed little difference between drilling on seedbeds which were burned, plowed, or had no preparation. Seed coverage was an important factor determining seedling emergence. Drilling at 6 pounds per acre on any of the seedbeds was superior to broadcasting at 6 or 12 pounds per acre. Broadcasting on plowed areas produced better stands than broadcasting on burned or untreated areas. Even the best stands from broadcast seeding were poor. In 1956 drilled plots produced 1.6 2-year-old plants per square foot and 517 pounds of grass per acre, as compared with .4 plants and 196 pounds for broadcast plots. This difference indicated that drilling is superior to broadcasting seed or pellets.

The seedbed preparation which best eliminated competing plants gave the most seeded plants and the highest yields. The first-year plant numbers were similar from drilling on plowed, burned, and untreated seedbeds. By the second year 99 percent of the plants on the untreated areas were dead and the remainder reached only 3 to 4 inches in height. In contrast, 2-year-old plants on plowed or burned seedbeds were 15 to 30 inches tall and producing several hundred pounds of herbage per acre. Each dollar expended on plowing or burning for seedbed preparation and drilling produced 3 to 7 times as much grass as a dollar spent on airplane broadcasting seed on the same type seedbed 5 to 40 times as much as one spent on airplane broadcasting pellets.

Comparable but poor stands were obtained from either airplane or hand broadcasting of pellets. With pelleting costs of 90 cents per pound of seed, on the basis of this study, coated seed pellets cannot be recommended for seeding range lands.

CRD, ARS, USDA, Logan, Utah.

McGinnies, W. J. EFFECTS OF PLANTING DATES, SEEDING RATES, AND ROW SPACINGS ON RANGE SEEDING RESULTS IN WESTERN COLORADO. J. Range Mangt. 13: 37-39. 1960.

Although satisfactory stands of crested wheatgrass and smooth brome were obtained by planting during any month from April to November in some years, during 1948-52, April 1 was the only planting date that gave consistently acceptable stands. All other planting dates resulted in failure or a poor stand in at least one year of the period.

No significant difference in yields of crested or intermediate wheatgrasses resulted from the different seeding rates used.

Intermediate and crested wheatgrasses were planted in rows 7, 14, and 21 inches apart in 1949. In 1956 and 1957, herbage yields were highest for the 21-inch spacing. No significant differences in yields resulting from row spacings were observed in 1952.

CRD, ARS, USDA, Fort Collins, Colo.

Dennis, R. E., Harrison, C. M., and Erickson, A. E. GROWTH RESPONSES OF ALFALFA AND SUDANGRASS IN RELATION TO CUTTING PRACTICES AND SOIL MOISTURE. Agron. J. 51: 617-621. 1959.

The yield of both alfalfa and sudangrass was associated with cutting interval--the oftener the plants were cut the less productive they were. Weeds were present in considerable amount and root production and winter survival of alfalfa were curtailed in all plots cut frequently. Regrowth was stimulated by frequent cutting for a short period, after which any new growth was definitely curtailed.

Water consumed, per unit of forage produced, decreased as length of cutting interval increased. Alfalfa cut frequently used only slightly less water than alfalfa cut at 4- or 6-week intervals, and less was used from the deeper soil horizons. The zone of most active water absorption by alfalfa plants cut at 4- and 6-week intervals shifted to a greater depth with time when rainfall was inadequate.

Most of the soil moisture used by sudangrass was stored prior to July, and came from the upper one foot of soil. Differences in moisture use between the four cutting treatments were very slight. Sudangrass used water more efficiently than did alfalfa during the period extending from early June to September. During the period of active plant growth, consumptive use of water per day was closely associated with rainfall.

It appears possible under Michigan conditions to manage alfalfa and sudangrass so that available moisture supplies can be used more advantageously in the production of a season-long forage supply for livestock.

J. Article 2406, Mich. Agr. Expt. Sta., East Lansing, Mich.

Cook, C. W. THE EFFECT OF SITE ON THE PALATABILITY AND NUTRITIVE CONTENT OF SEEDED WHEATGRASSES. J. Range Mangt. 12: 289-292. 1959.

During the spring grazing season from 1949 to 1957, an investigation was conducted in central Utah on seeded foothill range to determine the effect of site on palatability and chemical content of forage.

After only three years of grazing, more than 70 percent of the plants had been killed on poor sites, and less than 13 percent on favorable sites.

All wheatgrasses suffered about the same loss on unfavorable sites, but tall wheatgrass suffered the greatest loss and crested wheatgrass the least on favorable sites.

Palatability of all species was significantly greater on all unfavorable sites, compared to favorable sites.

Plants on favorable sites had about 50 percent more stems than leaves by weight, and plants on poorer sites had about equal portions of leaves and stems.

Both protein and ash were significantly higher in the entire plant on unfavorable sites, and cellulose was significantly higher on favorable sites. Both leaves and stems of crested and intermediate wheatgrasses were higher in lignin on favorable sites compared to unfavorable sites.

It was concluded that unfavorable sites deteriorate more rapidly than favorable sites when grazed together because: (1) The plants are more perferred and, consequently, are utilized more intensively on the unfavorable sites; and (2) these plants are not as tolerant to heavy use as plants on favorable sites because of the generally poorer growing conditions.

Utah State U., Logan, Utah.

Hyder, D. N., and Sneva, F. A. GROWTH AND CARBOHYDRATE TRENDS IN CRESTED WHEATGRASS. J. Range Mangt. 12: 271-276. 1959.

Herbage yields and root-carbohydrate concentrations in crested wheatgrass (Agropyron desertorum) were obtained in 1956 and 1957. In 1956 mature potted plants were used. Four plants were removed every 2 weeks to obtain herbage yields, root yields, and root-carbohydrate concentrations. In 1957 plants were taken directly from the field on 2 sites. On site I herbage and roots were removed every two weeks to obtain herbage yields and root-carbohydrate concentrations. On site II, trends in herbage yields and root-carbohydrate concentrations were taken at weekly intervals on untreated and on deheaded plants. Deheading was accomplished by cutting the culms at the base of the heads shortly after emergence from the boot.

Growing-season trends in the carbohydrate content of roots (with stem bases) were characterized by: (1) An early accumulation of carbohydrates to a level near 27 percent by the time of head emergence; (2) a moderate decrease at or just before flowering that was not altered by deheading; and (3) a final recovery during or just following seed formation to a level approximately the same as that attained by head emergence.

Within the framework of carbohydrate supply and demand there is opportunity to recognize species and environmental differences that are important in grazing management. Some phenological and morphological characteristics of crested wheatgrass were discussed as a basis for the appreciation of species differences in carbohydrate depletion and accumulation. The data presented on the growth and carbohydrate trends in crested wheatgrass support the contentions of early range readiness and high tolerance to grazing often attributed to this species.

CRD, ARS, USDA, Burns, Oreg.

Doll, E. C., Hatfield, A. L., and Todd, J. R. VERTICAL DISTRIBUTION OF TOPDRESSED FERTILIZER PHOSPHORUS AND POTASSIUM IN RELATION TO YIELD AND COMPOSITION OF PASTURE HERBAGE. Agron. J. 51: 645-647. 1959.

An experiment was conducted for two years on Pembroke sil to study the effects of topdressing P and K on yields of dry matter and uptake of N, P, and K by fescue-orchardgrass-Ladino clover pasture and on the distribution of P and K in the soil.

A yield response was obtained for P, but not for K. Uptake of N and P increased with both yield and rate of applied P.

Potassium fertilization did not affect the K content of the forage, so uptake of K was correlated only with yields. Soil tests indicated that considerable amounts of nonexchangeable K were removed by cropping at the lower rates of applied K. When rate of application exceeded crop removal, relatively small amounts of K were fixed in nonexchangeable form. This relatively low fixation is possibly due to the small volume of soil in contact with topdressed K.

Most of the topdressed P remained in the top inch of soil and no movement of P was detected below 3 inches.

When more K was applied than was removed by cropping, most of the K was held in the top 3 inches and no movement of K was detected below 6 inches.

Ky. Agr. Expt. Sta., Lexington, Ky.

Beaton, J. D., and Nielsen, K. F. THE AVAILABILITY TO ALFALFA OF PHOSPHORUS FROM TWELVE DIFFERENT CARRIERS. Canad. J. Soil Sci. 39: 54-63. 1959.

Availabilities of the phosphorus in twelve different phosphate sources to alfalfa were determined in a growth chamber. Two crops of alfalfa were grown on two soils of high base status, Machete stony sl and Westwold l. Fertilizer materials containing monocalcium phosphate or materials such as calcium metaphosphate which are converted to monocalcium phosphate brought about the greatest increases in yield. However, yield increases also resulted from treatments with the ammonium phosphates and orthophosphoric acid. Ammonium phosphate fertilizers were the most effective in increasing the percentage of phosphorus present in the alfalfa tissue. Ammonium phosphate and monocalcium phosphate materials were equally effective in increasing total phosphorus uptake by alfalfa. The amount of CO_2 soluble phosphorus extracted from the Westwold l, following treatment with the various phosphate sources, was correlated with the yield of the first crop of alfalfa. The average percent P in the alfalfa tissue was found to be correlated with the CO_2 soluble P. Both the $NaHCO_3$ and CO_2 extractable soil phosphorus levels of the Westwold l, after it had been treated with the different phosphate materials, were found to be highly correlated with the phosphorus uptake by the second crop of alfalfa and with the total phosphorus uptake.

U. Brit. Columbia, Vancouver, British Columbia, Canada.

McKell, C. M., and Williams, W. A. A LYSIMETER STUDY OF SULFUR FERTILIZATION OF AN ANNUAL-RANGE SOIL. J. Range Mangt. 13: 113-117. 1960.

A lysimeter study was initiated on Vista sl to study the fate of sulfur applied in gypsum to an annual-legume, rose clover. The gypsum leached rapidly in a season of heavy rainfall. Sulfur contributed by rainfall amounted to 21.4 pounds per acre, and sulfur adsorbed from the atmosphere contributed approximately 0. 1 pound per acre.

Use of the radioisotope S^{35} permitted identification of fertilizer sulfur in the percolate. In the growing season following fertilization 77. 0 percent of the sulfur applied in the 100-pound gypsum rate and 77. 9 percent of the sulfur applied in the 300-pound gypsum rate were accounted for in percolate collections.

Rose clover yield responded significantly to the higher levels of gypsum. The clover took up 30. 8 and 57. 4 percent of its tissue sulfur content from 100 and 300 pound applications, respectively.

CRD, ARS, USDA, U. Calif., Davis, Calif.

Neller, J. R., and Bartlett, F. D. GROWTH OF FORAGE CROPS ON LEON FINE SAND AS AFFECTED BY ADDING SULFUR TO ROCK PHOSPHATE. Soil Sci. 88: 331-335. 1959.

The low reserve of nutrient sulfur in uncropped Leon fs is shown by the significant decrease in the growth and sulfur content of cuttings of clover after the first year on plots which were well fertilized except for sulfur. The yield data indicate that gypsum, containing the equivalent of 16 pounds per acre of sulfur annually, supplies sufficient sulfur for growth of clover. Growth and percent phosphorus of clover and grass were increased, sometimes significantly, where sulfur had been added annually at the rate of 128 pounds per acre to treatments that received rock phosphate at 300 pounds per acre P_2O_5, as compared with rock phosphate only at 600 pounds P_2O_5, per acre. Growth of Pensacola Bahiagrass was significantly increased where a source of sulfur had been added to the fertilizer, possibly because the increased growth of clover earlier in the summer supplied more nitrogen to the grass.

Additions of sulfur, in increasing amounts, to rock phosphate treatments did not increase availability of phosphorus as shown by uptake of labeled phosphorus. Yields and percent total phosphorus and sulfur were increased but not to the 5 percent level of significance. In greenhouse studies where sulfur was used at higher rates, availability of the phosphorus of rock phosphate was increased somewhat.

Soil samples taken at the end of the experiment contained significantly more soluble phosphorus in the surface 3 inches than in the 3-6 and 6-12 inch layers. There was no significant differences between sulfur or gypsum treatments for either soluble phosphorus or pH.

U. Fla., Agr. Expr. Sta., Gainesville, Fla.

Norland, M. A., and Starostka, R. W. RESPONSE OF ALFALFA TO BORON FERTILIZATION OF SUNDRY ACID AND CALCAREOUS SOILS IN A GREENHOUSE STUDY. Agron. J. 52: 33-35. 1960.

Alfalfa was grown on five calcareous and five acid soils. Two of the acid soils were limed to obtain a measure of performance between three pH levels.

Neither deficiency nor toxicity symptoms of boron appeared on the calcareous soils with or without applied boron. Yield of alfalfa was not affected even though a significant increase in boron concentration of plant tissue was shown when boron was applied.

An increase in boron concentration and in some cases yield, resulted when boron was applied to acid soils. Boron deficiency symptoms were pronounced when boron was not applied.

A significant response in boron content of the alfalfa occurred when compared between a pH level of 5.5 and 7.5 on Chester soil with or without applied borax and on Evesboro soil when borax was applied.

SWCRD, ARS, USDA, Beltsville, Md.

Morris, H. D., and Jackson, J. E. SOURCE AND TIME OF APPLICATION OF NITROGEN FOR RYE FORAGE. Soil Sci. Soc. Amer. Proc. 23: 305-307. 1959.

The effectiveness of five sources of N for rye forage production was compared in a 3-year field experiment on Cecil sandy loam. Each source of N was applied at the rate of 120 pounds per acre by two methods: (1) All N at planting, and (2) one-half N at planting and one-half February 15.

Ammonium nitrate, sodium nitrate, urea, and ammonium sulfate were found to be equally effective as sources of N for rye forage. Calcium cyanamid was an inferior source of N producing approximately 400 pounds per acre less forage than the other fertilizers.

Applying the N in split application resulted in approximately 300 pounds per acre more forage than applying all the N at planting. All sources of N responded similarly to split-application. Applying all the N at planting increased the forage production at the first 2 clippings an average of only 100 pounds per acre for all N sources as compared to the split application.

Ga. Coastal Plain Expt. Sta., Tifton, Ga.

Oswalt, D. L., Bertrand, A. R., and Teel, M. R. INFLUENCE OF NITROGEN FERTILIZATION AND CLIPPING ON GRASS ROOTS. Soil Sci. Soc. Amer. Proc. 23: 228-230. 1959.

Strategic placement of P^{32} and root excavations revealed that roots of orchardgrass and bromegrass reached a greater depth when no N was applied. Nitrogen increased the root diameter and decreased the rate of elongation causing the plants to feed near the soil surface for a longer period of time. Defoliation stopped root growth within 24 hours and induced decomposition of the existing roots within 36 to 48 hours. Uptake of P^{32} placed in the existing root zone 24 to 48 hours after clipping was not detected until new roots reached the activated zone. New roots were initiated from basal leaf nodes of orchardgrass and rhizome nodes of bromegrass. Removal of all roots at the time of defoliation did not influence the rate of regrowth from transplanted sod plugs under optimum soil moisture conditions.

The author concludes that his results suggest that when grasses are defoliated, necessitating the formation of new roots in the surface area of the soil, the need for available surface nutrients and soil moisture is greatly increased.

Purdue U. Agr. Expt. Sta., Lafayette, Ind.

Adams, W. E., and McCreery, R. A. WHAT ARE THE FERTILITY NEEDS OF CRIMSON CLOVER WHEN GROWN WITH COASTAL BERMUDAGRASS?--AND COASTAL BERMUDAGRASS GROWN ALONE? Better Crops with Plant Food 43(4): 6-15. 1959.

Crimson clover grown with coastal bermudagrass showed: (1) Potash was the one nutrient most frequently limiting the stand and production of crimson clover; (2) 100 lbs. per acre of nitrogen applied to coastal bermudagrass increased the crimson clover's forage production; (3) the first 50 lbs. of phosphorus per acre increased crimson clover forage production almost 50% over the no phosphorus level; and (4) increasing rates of potash increased total uptake of both phosphate and potash, largely because of more forage produced.

Coastal bermudagrass grown alone showed; (1) That it can make efficient use of nitrogen only when other nutrients are adequately supplied; (2) forage production increases with increasing fertilizer rates--4.23 tons per acre from 100-50-50 (NPK) level, 5.26 tons from 200-100-100 (NPK), 7.5 tons from 400-200-200 lbs. NPK; (3) increasing nitrogen rates greatly stimulate potash uptake and removal from the soil; and (4) rising fertilizer levels decreased the amount of water used (or demanded) by each ton of coastal bermudagrass forage.

U. Ga., Athens, Ga.

Brown, B. A. BAND VERSUS BROADCAST FERTILIZATION OF ALFALFA. Agron. J. 51: 708-710. 1959.

Banded superphosphate caused much greater seedling growth of alfalfa than the same amounts mixed with the soil but subsequent yields did not differ significantly. Regardless of placement, limestone or muriate of potash did not benefit establishment but later was very effective in maintaining stands and yields.

Conn. (Storrs) Agr. Expt. Sta., Storrs, Conn.

Thompson, L. F., and Schaller, C. C. EFFECT OF FERTILIZATION AND DATE OF PLANTING ON ESTABLISHMENT OF PERENNIAL SUMMER GRASSES IN SOUTH CENTRAL OKLAHOMA. J. Range Mangt. 13: 70-72. 1960.

Summer perennial grasses adapted to the Southern Great Plains may respond to band seeding applications of fertilizer, even though established stands of the same species do not. The effect of only 10 pounds of P_2O_5 per acre applied in the row with the seed was still apparent and measurable three years later.

Grasses having strong seedling vigor, such as weeping lovegrass, blue panicgrass, and Caddo switchgrass, will respond to fertilizer grades such as 5-20-0 and 10-20-0.

Perhaps the greatest obstacle to successful establishment of seedings has been competing weedy vegetation--primarily prairie three-awn (Aristida oligantha). Quantity and grade of fertilizer used, planting date, and seedling vigor of the various species are interdependent on one another in establishing adapted grasses tested. This was especially true for switchgrass and lovegrass. Late April or early May plantings were best for King Ranch bluestem.

U. Ark., Fayetteville, Ark.

Mays, D. A., and Washko, J. B. THE FEASIBILITY OF STOCKPILING LEGUME-GRASS PASTURAGE. Agron. J. 52: 190-192. 1960.

Many of the pasture grasses and legumes presently grown in the Northeast produce low yields of forage during the mid-summer months, particularly in dry years. This presents a problem in providing adequate feed throughout the grazing season for the cattle and sheep in this area. Supplying the supplementary feed in the form of hay or silage is both expensive and time consuming. The development of management practices to insure adequate pasturage from existing grasslands during the critical mid-summer period could result in more economical livestock production.

During 1957 and 1958 two experiments were conducted at State College, Pa., to investigate the feasibility of stockpiling legume-grass pasturage. Swards containing birdsfoot trefoil and ladino clover in association with mixed grasses were grazed in rotation and also stockpiled until June 15, July 1, July 15, August 1, and August 15 before being grazed. Determinations of yield, forage consumption by cattle, and total digestible nutrient content were made at each grazing. Results from these experiments can be summarized as follows: (1) Birdsfoot trefoil-grass associations were superior to ladino clover-grass associations for stockpiling as indicated by yield, TDN content, and appeal to cattle; (2) stockpiled pasturage was consumed by cattle much less readily than that grazed at the rotation pasture stage (8 to 10 inches in height); (3) as great a consumption of TDN resulted in August from pastures initially grazed on June 15 as from pastures stockpiled until August 1 or 15 before grazing; (4) the TDN content of stockpiled pasturage decreased rapidly until July 1, after which only a slight decrease occurred; (5) pure stands of birdsfoot trefoil appear to offer greater potential for stockpiling than trefoil grown in association with grass; and (6) birdsfoot trefoil appears to be suitable for stockpiling until mid-July under Pennsylvania conditions. However, grasses should be grazed before they reach the early head stage, which occurs considerably earlier than this depending upon species.

J. Ser. Paper 2390, Pa. Agr. Expt. Sta., University Park, Pa.

Pedersen, T. T., and Buchele, W. F. HAY-IN-A-DAY HARVESTING. Agr. Engin. 41: 172-175. 1960.

Hay is the most important forage crop in the United States. Because field curing subjects hay to weather damage and as a result causes considerable loss of nutrients, it is important to find the best possible method of curing it.

By inserting a vapor barrier between the soil and the drying hay, the effect of evaporation from a wet soil was eliminated, and the time necessary to dry the hay to storable conditions was reduced.

When black polyethylene was used as a vapor barrier, it also absorbed radiation energy. The surface temperature was raised 40.3 deg. above that of the surrounding air.

The results of this study indicated that hay mowed before 10:00 a.m., crushed (clearance between rollers less than 0.015 in.) and placed on black polyethylene sheets, will dry to a storable moisture content of 20 percent before 4:00 p.m., and may be harvested the same day as cut.

Table 1.--The moisture content (wet basis) in the different samples after 22 1/2 hours of drying

Treatment	22 1/2 hours of drying Moisture content in percent (wet basis)
Crushed + dry soil	14.1
Crushed + dry soil + polyethylene	16.7
Crushed + wet soil + polyethylene	15.7
Crushed + wet soil	40.3
Uncrushed + dry soil	50.6
Uncrushed + dry soil + polyethylene	52.5
Uncrushed + wet soil + polyethylene	52.4
Uncrushed + wet soil	63.7

Table 2.--Required time for the different treatments to reach a moisture content of 20 percent (wet basis)

Treatment	Time, hours after cutting
Hard-crushed alfalfa on black polyethylene	4.0
Hard-crushed alfalfa on transparent polyethylene	6.5
Crushed alfalfa on black polyethylene	25.5
Crushed alfalfa on transparent polyethylene	28.5
Uncrushed alfalfa on black polyethylene	49.5
Uncrushed alfalfa on transparent polyethylene	51.5
Crushed alfalfa on ground	> 56
Uncrushed alfalfa on ground	> 56

J. Article 2448, Mich. Agr. Expt. Sta., East Lansing, Mich.

Bruhn, H. D. PERFORMANCE OF FORAGE-CONDITIONING EQUIPMENT. Agr. Engin. 40: 667-670. 1959.

If equipment is in good order and properly adjusted, delaying the crushing of alfalfa beyond the cutting time has little effect other than the loss in the higher drying rate of crushed material during the delay. The actual magnitude of loss varies directly with the effectiveness of the crushing, the extent of the delay, and the adequacy of the drying conditions.

The use of a forage crusher to increase the field drying rate of a crop is generally desirable, but the operation causes some clipping of small stems and leaves, part of which are apt to be lost in the harvesting process.

With similar types of crushing or conditioning equipment the degree of increase in drying rate is essentially in direct relation to the degree of crushing and clipping.

Different types of conditioning equipment vary widely in the degree of clipping to produce a given increase in drying rate.

U. Wisc., Madison, Wisc.

Boyd, M. M. HAY CONDITIONING METHODS COMPARED. Agr. Engin. 40: 664-667. 1959.

Tests have shown that the use of hay-conditioning machinery during good drying weather definitely reduces curing time, with the smooth-roll crusher showing a slightly better advantage than the corrugated roll crimper.

The use of the flail-type forage harvester as a conditioning unit shows the advantage of a still faster curing rate coupled with a shorter time requirement for mowing and conditioning a given area. The problem of losses in subsequent handling, however, bears further investigation.

Following are some of the advantages to be gained from hay conditioning: (1) Conditioning can reduce drying time by about 30 percent; (2) shortening the time that hay remains in the field after cutting improves the chances of putting it up without damages; (3) field losses due to shattering are reduced as curing time and the amount of turning and tedding are reduced; and (4) conserves color and feed value through shorter exposure and less shattering.

U. Mass., Amherst, Mass.

Voigt, J. W. ECOLOGY OF A SOUTHERN ILLINOIS BLUEGRASS-BROOMSEDGE PASTURE. J. Range Mangt. 12: 175-179. 1959.

In an 80-acre southern Illinois pasture dominated by Kentucky bluegrass and broomsedge, yield and consumption studies were carried out during the summer months of 1952, 1953, and 1954. Yields and consumption were measured for three components (bluegrass, broomsedge, and forbs) using the portable exclosure (cage) method and selective clipping.

The year 1952 was a drought year. Total production was 0.84 tons per acre, and consumption was 0.57 tons per acre, of which 50 percent was broomsedge.

Another drought year followed. Production and consumption steadily declined to the end of the season. Total yield was 0.80 tons per acre. Bluegrass made up 25 percent, broomsedge 53 percent, and forbs 21 percent of the production. Consumption was 0.44 tons per acre, and 54 percent of all forage consumed was broomsedge.

More normal climatic conditions prevailed during 1954. Total yield for the year was 0.98 tons per acre, of which about 40 percent was broomsedge and 40 percent was bluegrass. The consumption was 0.63 tons per acre, of which bluegrass was 38.1 percent and 38.4 percent was broomsedge.

Southern Ill. U., Carbondale, Ill.

Chapman, C. J. NITROGEN PLUS MINERALS PLUS WATER EQUALS ABUNDANT PASTURE. Solutions 1(2): 8-9. 1960.

In a fertilizer irrigated pasture test in Wisconsin clipping tests showed that the profit per acre was $120 per acre for the fertilized plots over the nonfertilized.

The author gives the following reasons why it will pay to fertilize pastures: (1) A high nitrogen fertilizer applied as a top-dressing either in late fall or early spring will give a week to 10 days earlier grazing; (2) it will produce not only a lush, early growth of grass, but will extend the pasture season into late July; and even though dry weather stops growth, the accumulated dry grass still has a high feeding value and will continue to furnish good feed for livestock during the dry period of the summer; (3) pasture improvement by direct fertilization with 16-8-8, 10-10-10 or straight nitrogen (backed up with minerals) has been proven to be economically sound; (4) pasture grass fertilized with a high nitrogen mixture is more palatable, and the feed is richer in proteins, minerals, and vitamins; (5) by thickening the turf, water-holding capacity is increased and losses by run-off is slowed down; (6) fertilized pasture chokes out many types of weeds and reduces damages from infestation by grubs; (7) more feed from fertilized pasture cuts down on cash outlay for protein feed supplements; (8) pasture improvement by lowering feed production costs will go a long way toward relieving the government of the need for dairy price supports; (9) more acres of good pasture fits into a program of soil conservation and a grassland type of farming, cuts down on man-hour and machinery costs by letting the cows harvest their own feed; and (10) irrigation water, when available, applied through a sprinkler system in dry weather will keep the grass green and growing, and has been found to be a profitable way of increasing milk production.

U. Wisc., Madison, Wisc.

Gilbert, W. B., and Chamblee, D. S. EFFECT OF DEPTH OF WATER TABLE ON YIELD OF LADINO CLOVER, ORCHARDGRASS, AND TALL FESCUE. Agron. J. 51: 547-550. 1959.

The effect of depth of water table, with and without surface watering, on shoot yields of Ladino clover, orchardgrass, and tall fescue was studied in the greenhouse, using a Bladen silt loam from the Tidewater area of North Carolina. The water table depths below the soil surface were: 6 inches; 6 inches with aeration at 6 inches; 12 inches; 6 inches for 1 week then 20 inches for 3 weeks; and 20 inches. Two 1/2-inch increments of water were applied weekly to the surface-watered treatments.

All species produced the highest yield when the water table was at 6 inches. Comparison of the 6-inch water tables with the 3 lower ones, shows Ladino clover had a 20% higher yield from the 6-inch water tables, while orchardgrass and tall fescue produced 54 and 71% more, respectively, from the 6-inch water tables.

The addition of water to the surface resulted in a large increase in yields with orchardgrass and tall fescue grown above the 12-inch, 6- to 20-inch water tables, but a depression in yields above the 6-inch water table. Ladino clover had a significant increase in yield from surface watering at all water table depths.

The root density in the 6- to 12-inch soil layer was greatly reduced by the 6- to 20-inch fluctuating water table as compared to the stable 20-inch table.

It would appear that orchardgrass could be more widely used in the Tidewater area of North Carolinaif the water table were lowered to at least 12 to 20 inches. Under conditions of normal rainfall, tall fescue would be more tolerant of a high water table (6 inches) than orchardgrass, but yields of both grasses would be materially increased by lowering the water table.

Ladino clover would give excellent production with the water table at a depth of 6 to 20 inches. In time of drouth, subirrigation would not be as effective with orchardgrass and tall fescue as with Ladino clover.

N. C. Agr. Expt. Sta., Raleigh, N. C.

Day, A. D., and Tucker, T. C. PRODUCTION OF SMALL GRAINS PASTURE FORAGE USING SEWAGE EFFLUENT AS A SOURCE OF IRRIGATION WATER AND PLANT NUTRIENTS. Agron. J. 51: 569-571. 1959.

Eight experiments were conducted over a two-year period (1957-58) at Cortaro, Arizona, to compare the pasture forage production of small grains irrigated with sewage effluent with the pasture forage obtained when small grains were irrigated with regular irrigation water and fertilized with different amounts of commercial fertilizer.

Winter pasture forage yields equivalent to 11.14 tons per acre were obtained from barley irrigated with sewage effluent with no additional fertilizer. Barley produced 112% more forage on plots treated with sewage effluent alone than was produced on the check plots that received pump water with no additional fertilizer. Barley was more sensitive to the detrimental effects of sewage effluent than wheat or oats.

When wheat was grown with pump water with no additional fertilizer it produced 3.50 tons of forage per acre. Wheat plots that received sewage effluent with no additional fertilizer produced 263% more pasture forage than check plots that received pump water with no additional fertilizer. In general, as the amount of nitrogen fertilizer was increased, the average oat forage yield increased.

Barley provided more early winter pasture forage than either wheat or oats. Oats produced more vegetative growth later in the winter pasture season than either barley or wheat.

City sewage effluent can be utilized efficiently in the production of small grains pasture forage in the irrigated areas of the Southwest and possibly in other areas of the United States and the world where small grains benefit from supplemental irrigation water and fertilizer.

Ariz. Agr. Expt. Sta., U. Tuscan, Tuscan, Ariz.

Klages, M. G., and Asleson, J. A. RELATIONSHIP BETWEEN BOTANICAL COMPOSITION, NITROGEN RESPONSE, AND WATER TABLE LEVEL ON WET MEADOW SOD. Agron. J. 51: 562-565. 1959.

Irrigated native hay is an important forage crop in Montana and other western states. Unfortunately, yields are low because usual irrigation practices tend to encourage sedges, rushes, and other water-loving species with low yield potential. It would seem that the most promising methods of improving yield would be through water control and fertilization.

Soil, with sod intact, from a wet native meadow was subjected to various water and nitrogen fertilizer treatments. Measurements of yield, chemical composition, and botanical composition were made over a 3-year period. The relationships between the various measurements were analyzed statistically. The botanical composition of the sod quickly adjusted to the changed environment. Yield was found to be related to botanical composition. Both yield and grass content were increased by nitrogen when the water table was controlled at 24 inches, but any increase was slight with a surface water table. The response to nitrogen was not as great with oats grown for hay as with native hay. It was concluded that the primary effects of the treatments were on botanical composition and that yield differences were a result of these effects.

Mont. Agr. Expt. Sta., Mont. State Col., Bozeman, Mont.

Kerr, H. D., and Klingman, D. L. WEED CONTROL IN ESTABLISHING BIRDSFOOT TREFOIL. Weeds 8(2): 157-167. 1960.

Lack of seedling vigor is a serious limitation to obtaining adequate stands of birdsfoot trefoil (Lotus corniculatur L.). Slow seedling growth makes establishment difficult because competition from weeds or companion crop plants often eliminates the young legume seedlings soon after they emerge.

Mowing alone and in combination with dalapon and TCA was studied for weed control and effect on establishment and growth of birdsfoot trefoil. The effects of separate weed components on stand and stem development of seedling birdsfoot trefoil were evaluated in a handweeding study. Nodulation of birdsfoot trefoil as affected by several rates of dalapon was studied in the field and in a greenhouse test.

Mowing alone was not adequate for weed control in birdsfoot trefoil because it removed the canopy of broadleaved weeds which reduced the competition and released the weed grasses allowing them to compete with the birdsfoot trefoil seedlings. In a handweeding study, weed grasses alone were more detrimental to the growth and development of birdsfoot trefoil than broadleaved weeds alone or weed grasses and broadleaved weeds combined.

An application of 3 pounds of dalapon in mid-May followed by mowing 2 weeks later, a second 3-pound dalapon treatment a month later, and 2 more mowings resulted in about 2 tons of birdsfoot trefoil hay the subsequent year. Three pounds of dalapon per acre in June combined with 3 mowings during the summer resulted in 1 ton of ovendry trefoil herbage per acre the next year. In contrast, four mowings alone resulted in only 80 pounds per acre and 3 mowings in only 100 pounds.

Dalapon did not inhibit nodulation of birdsfoot trefoil when it was used at rates of 6 pounds per acre or less. These rates were entirely adequate for control of weed grasses.

CRD, ARS, USDA, Pullman, Washington

Schreiber, M. M. PRE-EMERGENCE HERBICIDES ON ALFALFA AND BIRDSFOOT TREFOIL. Weeds 8(2): 291-299. 1960.

The first step in a satisfactory forage-legume program on the farm is the establishment of the legume. Success or failure here can mean the difference between a continued efficient rotation system and a financial loss. Many farmers have been reluctant to plow up old seedings at the proper time because of the cost of new seedings and the possibilities of seeding failures. Also, new seedings may appear successful in the seeding year only to be lost during the first winter. This paper is a report of 3 years' study at Ithaca, New York, on the use of herbicides applied pre-emergence to aid in the establishment of forage legumes without a companion grain crop.

The author summarizes the work as follows: (1) Neburon, 1 to 4 lb/A applied pre-emergence, controlled the majority of common annual broadleaved weeds and weedy grasses in 1958 without injury to alfalfa. (2) With the use of an effective herbicide such as neburon and without the use of a companion crop, a yield of approximately 1 ton/A of pure alfalfa was produced in the seeding year. (3) The reduction in weed competition in the early stages of alfalfa establishment produced a greater percentage of more highly developed alfalfa plants on the basis of dry weight of roots, crown diameter, and root diameter. These highly developed alfalfa plants produced greater regrowth before over-wintering. (4) Birdsfoot trefoil appeared to be extremely susceptible to rates of neburon above 1 lb/A but neburon may hold some promise at 1 lb/A as a pre-emergence herbicide in the establishment of birdsfoot trefoil. (5) Significant yield increases over the untreated checks were found in the year after treatment with neburon. Birdsfoot trefoil showed greater yield differences than alfalfa. And (6) EPTC as a surface application at 8 lb/A in 1958 did not give satisfactory broadleaf or grass weed control but was non-injurious to both alfalfa and birdsfoot trefoil.

CRD, ARS, USDA, Purdue U., Lafayette, Ind.

Williams, W. A., Leonard, O. A. EFFECT OF 2, 4-D ON THE GROWTH, SEED PRODUCTION, AND SEED VIABILITY OF ROSE CLOVER. Agron. J. 51: 383-387. 1959.

Amine and ester formulations of 2, 4-D did not reduce the germination of seed of rose clover (Trifolium hirtum All.) produced after applications made during the rosette and early bud stages. However, seed and forage yields were reduced by both formulations, the ester formulation being more toxic than the amine. Both formulations drastically reduced seed production and germination when applied during the bloom stage. Neither form caused significant damage if applied when seed was ripe.

U. Calif., Davis, Calif.

Crawford, H. S. EFFECT OF AERIAL 2, 4, 5-T SPRAYS ON FORAGE PRODUCTION IN WEST-CENTRAL ARKANSAS. J. Range Mangt. 13: 44. 1960.

In May 1957, several hardwood tracts in the Ozark mountains near Paris, Arkansas, were aerially sprayed with 2, 4, 5-T in order to convert them to range. A fixed-wing aircraft applied to each acre 2 pounds of iso-octyl ester of 2, 4, 5-T mixed with one gallon of diesel oil and 3.5 gallons of water. The mixture was intended to rid the tracts of trees like post oak (Quercus stellata), blackjack oak (Q. marilandica), and hickories (Carya spp.).

Production of grass, forbs, and browse under five feet in height was measured in September 1957 and 1958 on adjacent sprayed grasses were little bluestem (Andropogon scoparius), broomsedge (A. virginicus), panicums (Panicum spp.), and poverty oatgrass (Danthonia spicata). The most important forbs were asters (Aster spp.), various legumes, horseweed (Erigeron canadensis), fireweed (Erechtites spp.), and pokeweed (Phytolacca americana). Various species of oak, hickory, blueberry (Vaccinium spp.), grape (Vitis spp.), and sumac (Rhus spp.) composed the bulk of woody growth.

Per-acre yields of air-dry forage on sprayed and unsprayed areas were:

	Sprayed areas		Unsprayed areas	
	1957	1958	1957	1958
Grass	564	873	433	321
Forbs	102	716	275	119
Browse	101	279	375	277
Total	767	1,868	1,083	717

The large decrease in browse plants in 1957 was caused mainly by defoliation and killing of the oaks--species of low browsing value. In 1958, browse yields increased to 279 pounds per acre--an amount equal in weight to that on unsprayed areas. The sprayed areas, however, produced more browse plants of the species preferred by deer, such as blueberry and grape.

Southern Forest Expt. Sta., FS, USDA, New Orleans, La.

Aikman, J. M., and Sylwester, E. P. EFFECTS OF TIME AND METHOD OF TREATMENT ON TREE KILL AND BLUEGRASS RECOVERY. Iowa Acad. Sci. Proc. 66: 103-112. 1959.

Box elder trees in replicated plots within four seasonal blocks mostly ranged in age from 17 to 24 years, in breast-high diameter from 2 to 8 inches, and in height from 18 to 24 feet. Tree cutting at 3 inches and at 1 foot was done with a chain saw; and a brush killer--fuel oil mixture, at the rate of one quart of concentrate to 5 gallons of fuel oil and one quart to 10 gallons, was applied to the stumps. Resprouting from stumps cut at both heights and in four different seasons was controlled by both concentrations of the mixture to the extent of 99.8 percent. Untreated stumps sprouted almost 100 percent. Basal treatment of standing trees bordering the cleared blocks gave 100 percent kill with the 1 to 5 mixture, but only imperfect kill with the 1 to 10 mixture.

Weed growth was greater in the two blocks cleared before growth started in the spring than in the two blocks cleared in July and October. Yield of bluegrass in October, 1958, was about 60 percent greater in the first two clearings than in the last two and in the adjacent uncleared check. This early sampling seemed to test the effect of time elapsed since clearing, rather than season of clearing. Low-cut, treated stumps with tree removal gave excellent sprout control, and as a method was superior to (1) high cut stumps, (2) no tree removal, and (3) basal treatment of standing trees in the control of weeds, improvement of bluegrass growth, and utilization, sanitation, and general husbandry.

Iowa Agr. and Home Econ. Expt. Sta., Ames, Iowa.

Rangelands

Tschirley, F. H., and Martin, S. C. GERMINATION AND LONGEVITY OF VELVET MESQUITE SEED IN SOIL. J. Range Mangt. 13: 94-97. 1960.

Velvet mesquite (Prosopis juliflora var. velutina (Woot.) Sarg.) reproduces only from seed. Therefore, the germination rate and longevity of the seed in the soil affect not only the spread of the species but also reinvasion after control.

Rate-of-germination tests showed that most of the seeds germinated in July and August of the summer following an August planting date. Only 15.8 percent of the hulled seed germinated, but 44.7 percent of the seed planted in pod segments germinated. Longevity tests showed that some seeds are still viable after 10 years of burial even where soil moisture has been adequate for germination. The discovery of one live, recently-sprouted seedling shows that germination can occur after 10 years of burial in soil.

CRD, ARS, USDA, Tuscon, Ariz.

Ehrenreich, J. H., and Crosby, J. S. FORAGE PRODUCTION ON SPRAYED AND BURNED AREAS IN THE MISSOURI OZARKS. J. Range Mangt. 13: 68-69. 1960.

Some partially wooded areas in the Missouri Ozarks are better suited to producing herbaceous vegetation than timber. One of the biggest deterrents to maximum herbage production on such land is brush crowding out the grass. The problem has been to find ways to control the undesirable hardwood. Burning the woods in the spring has been the traditional way to solve this problem. However, it has been demonstrated that the new chemical plant killers do a more effective job.

A study was made in Dent County, Missouri, to evaluate the effect of both a typical spring burn and herbicides on herbage yield and composition. The soil is a Clarkville stony 1 with a surface that consists mainly of cherty stones covered by a light leaf litter.

Forest cover in the area is primarily blackjack (Quercus marilandica) and post oak (Q. stellata) with some black oak (Q-velutina), hickory (Carya), sassafrass (Sassafras albidum), and other hardwood species. The stand studied consisted almost entirely of sprouts about 6 to 10 feet high.

Sprayed areas produced more herbage of quality than either spring burned or control area. Spring burning in fact did not significantly increase total yield at all. Five years after treatment with 2, 4, 5-T, total herbage yield on sprayed areas was about 4.5 times greater than on burned areas and about 5.5 times greater than on control areas. Little bluestem and other perennial grasses accounted for practically all of the increased yield on sprayed areas. There was no significant difference in yield of forbs on sprayed, burned, or control areas.

The average yield of little bluestem was about 800 pounds per acre on sprayed areas, and only 70 and 50 pounds per acre on burned and control areas, respectively. This species increased so greatly on sprayed areas because of the great reduction in hardwood competition.

Little bluestem occurred in all sprayed plots and only about 80 percent of burned and control plots. It contributed about 65 percent of the total herbage yield on sprayed areas, and only about 25 percent of the total yield on burned and control areas.

Two other very palatable native grasses--Indian grass (Sorghastrum nutans) and switchgrass (Panicum virgatum)--yielded about 100 pounds per acre on the sprayed areas and nothing on burned or control areas.

Columbia Forest Res. Center, Cent. State Forest Expt. Sta., FS, USDA, Columbia, Mo.

Fisher, C. E., and Quinn, L. CONTROL OF THREE MAJOR BRUSH SPECIES ON GRAZING LAND IN THE UNITED STATES, CUBA, AND BRAZIL. J. Range Mangt. 12: 244-248. 1959.

The value of brush control on grazing lands depends largely on the potential productivity of the land and the kind and amount of brush. For instance, under conditions where rainfall is limited, grazing trials by the Texas Agricultural Experiment Station at Spur show that control of open to moderate stands of mesquite increased steer gains on average of 34 pounds per head during the summer months. Moreover, on sites where the soils are deep and fertile, and moisture conditions are favorable the carrying capacity of the land has been increased three-fold or more by the control of mesquite and establishment of highly productive pasture grasses. On the other hand, where brush infests land that is low in potential productivity due to low rainfall, poor soils, topography, or other reasons, only limited benefits may be expected from the control of brush.

In Cuba control of marabu together with sodding to colonial guineagrass has increased the carrying capacity of the land from practically nothing up to one animal to 4 acres. Similar results have been obtained in Brazil in the control of dense stands of leiteiro and mixed brush. Other benefits derived from control of brush include the increased ease of handling livestock, lower death losses of grazing animals, and the opportunity to use more efficient pasture and livestock management practices.

Supt. Substation No. 8, Tex. Agr. Expt. Sta., Lubbock, Texas.

Platt, K. B. PLANT CONTROL--SOME POSSIBILITIES AND LIMITATIONS. II. VITAL STATISTICS OF RANGE MANAGEMENT. J. Range Mangt. 12: 194-200. 1959.

A description of undesirable range plants, tables showing the location of undesirable range plants, and tables showing recommended control measures and estimated control cost for the various undesirable range plants are presented.

Bur. Range Mangt., Salt Lake City, Utah.

Greene, G. E., and Aldworth, W. R. SAGEBRUSH OR GRASS? J. Soil and Water Conserv. 14: 170-171. 1959.

Removal of big sagebrush (Artemesia tridentata) promises to be an effective practice for bettering the range in the Crow Creek area of the Townsend Ranger District, Helena National Forest.

Of the three methods employed, burning was the cheapest. The chief disadvantage of burning is the danger of uncontrolled fire, which may do more damage than good. Too hot a fire will kill desirable understory grasses and perennial weeds. A fire not hot enough will not thoroughly kill sagebrush. In addition, burning generally requires reseeding with no grazing the following season and only light to moderate grazing the second season.

Although roto-beating does a good job of sagebrush removal, the method is limited to relatively level and rock-free areas. The method is expensive. On the Crow Creek tests, it cost $25. 00 an acre to remove sagebrush by roto-beating.

Aerial spraying, because of the economy involved, may be a suitable method. On the Crow Creek range the cost was about $3. 00 an acre. One disadvantage of spraying is that the chemical may kill desirable weeds and shrubs.

Sagebrush control has been recommended primarily for ranges used by livestock in the spring, fall, and summer, but not for those grazed chiefly in winter. On winter ranges, sagebrush, especially black sage (Artemesia nova), is often a desirable forage. Likewise, control on big-game winter ranges is not recommended where silver sage (Artemisis cana) is an important source of browse.

Range Conserv., FS, USDA, Spokane, Wash.

McKell, C. M., Majro, J., and Perrier, E. R. ANNUAL-RANGE FERTILIZATION IN RELATION TO SOIL MOISTURE DEPLETION. J. Range Mangt. 12: 189-193. 1959.

This study reports the pattern of moisture depletion under moderately high rates of nitrogen and phosphorus fertilization. A completely randomized block experiment with four treatments replicated four times was established on a fine sandy loam soil with plots 10 x 11 feet centrally equipped with Bouyoucos blocks for measuring soil moisture depletion were read every two weeks during the growing season. Fall applied fertilizer consisted of 150 pounds of nitrogen per acre, 200 pounds of phosphorus per acre, 150 pounds of nitrogen plus 200 pounds of phosphorus per acre, and none (check).

Fertilization of annual range plants with nitrogen resulted in a greater forage production and earlier maturity than no nitrogen. Combination of nitrogen and phosphorus resulted in a significant interaction that gave increased yield of forage.

Abundant plant growth and more uniform early plant maturity due to the application of nitrogen removed more soil moisture than is removed from the soil where plants do not receive nitrogen. Depletion of soil moisture early in the spring and a high rate of moisture use occur as a result of the application of nitrogen. Growth of summer growing annual weeds is considerably retarded by depletion of soil moisture at all depths where nitrogen is applied.

CRD, ARS, USDA, Davis, Calif.

Huffine, W. W., and Elder, W. C. EFFECT OF FERTILIZATION ON NATIVE GRASS PASTURES IN OKLAHOMA. J. Range Mangt. 13: 34-36. 1960.

The effect of repeated application of fertilizers on native grass pastures was determined in the growing season of 1957 and 1958. These pastures were located in the central cross-timber area of Oklahoma. The land had been described and designated as two types: (1) Virgin, in the sense that it had never been plowed; it had been cleared of timber and scrub brush; and (2) eroded and abandoned crop land which had been allowed to return to native grass over a period of 20 years or more. Each land type was equally divided into two pastures one of which was fertilized. The fertilized pasture of each land type received an application of 300 pounds of superphosphate 0-20-0 per acre in 1952 and again in 1955, and an annual application of 100 pounds of ammonium nitrate 33-0-0 per acre applied in late May of each year until the grazing study was terminated at the end of the 1956 season. The four native grass pastures reported in this study were not grazed in 1957 or 1958.

In August of 1957 and July, 1958 ten samples of vegetation selected at random were obtained from each pasture. Each sample was separated into three categories: grasses, weeds, and legumes. Weed production expressed in percent of the total yield of vegetation for both years was 16 on the eroded non-fertilized pasture compared to 50 on the fertilized eroded pasture. In the non-fertilized unplowed pasture 22 percent of the total yield for both years were weeds, whereas weeds constituted 42 percent of the vegetation harvested from the fertilized unplowed pasture.

The total yield of grass for this two year period was slightly greater from the non-fertilized pastures regardless of land condition where they were developed.

Pastures which were fertilized produced the greatest yield of oven-dry material per acre each year. This primarily resulted from greater weed production.

Native legumes contributed little, if any, to the total production even when fertilized.

Okla. State U., Stillwater, Okla.

Kipple, G. E., and Retzer, J. L. RESPONSE OF NATIVE VEGETATION OF THE CENTRAL GREAT PLAINS TO APPLICATIONS OF CORRAL MANURE AND COMMERCIAL FERTILIZER. J. Range Mangt. 12: 239-243. 1959.

Manure and several commercial fertilizer treatments were applied to a good stand of native short-grass vegetation on the Central Plains Experimental Range in northeastern Colorado during 1951, 1952, and 1953. The longtime average annual rainfall for the study area is about 12 inches. The rainfall during the study period was comparable to the longtime average, except for an acute drought in 1954. General observations were made each year from 1952 to 1956, and plot records of density and herbage production were taken in 1952, 1953, and 1956. Fodder analyses of the mature blue gramma herbage from plots that had received four of the fertility treatments and from the untreated plots were made in 1956.

Manuring was the most effective treatment. It increased herbage yields 15 to 50 percent. Yields from plots treated with commercial fertilizers seldom exceeded those from the untreated native range. Commercial nitrogen applied in 1953 had little, if any, effect upon the protein content of blue gramma herbage produced in 1956. Manue and phosphorus treatments improved the protein content of blue gramma herbage. Manure and nitrogen reduced the phosphorus content, but phosphorus fertilization gave little increase in the phosphorus content of the herbage.

CRD, ARS, USDA, Fort Collins, Colo.

Beaton, J. D., Watten, R. A. J., and Hubbard, W. A. NITRATE-SUPPLYING POWER OF EIGHT GRASSLAND SOILS OF THE KAMLOOPS, B. C., AREA AND CORRELATION WITH RANGE FORAGE PRODUCTION. Canad. J. Soil Sci. 40: 63-70. 1960.

The formation of nitrate in eight grassland soils of the Kamloops, British Columbia, area was studied using a laboratory incubation technique. All the accumulative totals of nitrate nitrogen produced by these soils were low and suggest that the amount of nitrate formed may be inadequate for optimum plant growth. The desert-like soils, although they are regarded as being members of the Brown great soil group, released the most nitrate nitrogen. The Shallow and Degrading Black soils released nitrate in intermediate amounts while the Brown and Dark Brown soils produced the smallest quantities. The correlations between the accumulative total of nitrate released during incubation with: C/N ratio, total nitrogen, andorganic matter, were not highly significant. Poor correlation was obtained in the comparison between the accumulative total nitrate formed and the forage produced during the period 1954-1957.

U. Brit. Columbia., Vancouver, British Columbia, Canada.

McWilliams, J. L., and Van Cleave, P. E. A COMPARISON OF CRESTED WHEATGRASS AND NATIVE GRASS MIXTURES SEEDED ON RANGELAND IN EASTERN MONTANA. J. Range Mangt. 13: 91-94. 1960.

In 1940 plantings of crested wheatgrass and mixtures of native species were made on formerly cultivated land in Prairie County, Montana. Green needlegrass and western wheatgrass were the dominant native species used in the mixtures. These plantings have been grazed since 1942.

A study of the plantings 17 years after seeding brought out these points: (1) Herbage yield by the native mixture was 58 percent greater than for crested wheatgrass in a pasture grazed April 15 to December 15 annually for 16 years; (2) herbage yield of the native mixture was 36 percent greater than for crested wheatgrass in the pasture used for spring and winter grazing; (3) the native mixture controlled erosion considerably better than the crested wheatgrass; (4) continuous use April to December permitted an increase of needle-and-thread grass in the mixture seeded area and a reduction in the vigor and yield of the crested wheatgrass; (5) with spring and winter grazing, green needlegrass increased and encroached on the adjoining crested wheatgrass strips; and (6) for long time production and erosion control under the conditions studied, mixtures of native species are better for range reseeding than crested wheatgrass alone.

CRD, ARS, USDA, Tuscon, Ariz.

Douglas, D. S., Hafenrichter, A. L., and Klages, K. H. CULTURAL METHODS AND THEIR RELATION TO ESTABLISHMENT OF NATIVE AND EXOTIC GRASSES IN RANGE SEEDINGS. J. Range Mangt. 13: 53-57. 1960.

The choice of land preparation methods for reseeding range lands depended, to a considerable degree, upon the kind and amount of vegetation on the land. Summer fallow was the best method, especially if weedy, fire-tolerant perennials were abundant. Burning was effective if big sagebrush and cheatgrass were the only plants present, but disking just before planting was more effective than burning. Planting directly into unprepared land gave the poorest stands and slowest development.

Five methods of planting were compared on summer fallow. The deep-furrow drill gave best results, broadcasting was poorest, and seeding with a doubledisk drill gave intermediate results. Planting the grass in alternate rows with winter wheat resulted in good establishment. When this method was used erosion and weeds were never serious. Seedings made in grain stubble with a deep-furrow drill consistently made good stands, but they developed slowly.

Fall plantings produced better stands and higher yields than spring plantings. Spring plantings were variable but presented possibilities on high capability land and with the more intensive land preparation methods.

Crested wheatgrass established easier and faster than Whitmar wheatgrass or bluebunch wheatgrass and reached grazing readiness one or two years earlier. As the stand reached maturity, Whitmar and bluebunch wheatgrass first equalled, then exceeded production of crested. Crested provided spring-fall use and Whitmar and bluebunch late-spring, summer, fall, or winter grazing. Thus they supplement each other.

Siberian wheatgrass established more rapidly and outproduced standard and Fairway crested wheatgrasses. Siberian had more desirable forage characteristics and stayed green about 10 days later into the season. Ladak alfalfa planted with grass was established in good years and had recognized value in the mixture.

Sherman big bluegrass was even earlier than crested for seasonal grazing readiness but more difficult to establish. Russian wildrye was established easily and contributed to lengthening the grazing season with high quality feed, but the production of dry matter was low. Tall wheatgrass established well but was short-lived under the low rainfall conditions of these studies. Pubescent and intermediate wheatgrasses were erratic establishment and production. They were below their range of adaptation.

Mixtures containing understory grasses have recognized advantage for soil and water conservation on range lands but exceptional management is needed to maintain the balance of species.

The choice of a species depends upon the seasonal feed requirements of the ranch operation, the soil and climatic resources and the grazing management plan for the ranch.

SCS, USDA, Aberdeen, Idaho.

McDonald, L. J. GRASS MAKES THE DIFFERENCE IN RAINFALL PENETRATION OF GRAZING LAND. Soil Conserv. 25: 154-155. 1960.

One night, 1.65 inches of rain fell in 1 1/2 hours. In a native pasture on the red shale hills near Elk City, Oklahoma, moisture penetration was found as follows: (1) Where the range was in Poor condition and grass cover was sparse, the moisture had penetrated only 3 inches and there was evidence that most of the water had been lost through runoff; (2) where the range was in Fair condition the moisture penetrated to a depth of 10 inches and there was little evidence of runoff from this area; and (3) where a dense stand of sand bluestem was in Excellent condition, the moisture penetration was 30 inches. There was convincing evidence that the amount of grass cover and the depth of moisture penetration were closely related; the greater the amount of cover, the greater the depth of moisture penetration.

In the limestone area of southern Oklahoma similar findings were found near Ardmore, Oklahoma. On a range in Poor condition and badly overgrazed, the water intake was only 4 inches in a 2-hour period of steady rainfall. The intake was 1.2 inches the first 15 minutes of the test, but only 2 inches the last 15 minutes of the period. The intake was 10 inches in the same 2-hour period on a nearby range in Excellent condition and properly grazed. The rate of intake varied from 2 inches the first 15 minutes to 1 inch the last 15-minute period. The amount of cover on the land influenced the temperature of the soil. On the range in Poor condition, the soil temperature--2 inches below the surface--was 135° F. as compared to a temperature of 95° F. on the site in Excellent condition. The air temperature was 105° F. at this time.

Asst. State Conservationist. SCS, USDA, Stillwater, Okla.

Reppert, J. N. FORAGE PREFERENCE AND GRAZING HABITS OF CATTLE AT THE EASTERN COLORADO RANGE STATION. J. Range Mangt. 13: 58-65. 1960.

A study was conducted at the Eastern Colorado Range Station to determine what species of native forage are selected and consumed by cattle. Related grazing habits were also studied. The method used consisted of observation of heifers which were grazing unrestricted in native sandhill pastures.

This study revealed that the heifers showed a variable preference for different species at different times of the year. Sandreed was observed to be the main constituent of the diet during the late winter and summer period of observation. Blue grama was important during the winter periods. Sandreed and blue grama were very abundant and available compared to the other major species, needle-and-thread. Needle-and-thread was important during spring and fall months. Other grass species made significant contributions during certain periods. Considerable use was made of other cool season species such as sun sedge and western wheatgrass during the early spring. Forbs were of some importance during the growing season. Shrub use, both sand sagebrush and yucca, was of importance primarily in winter.

Grazing heifers showed a tendency to select green forage. Favor was also shown for leaves in preference to stems. With the passage of the growing season, the ingested forage was judged to become increasingly more stemy.

It was concluded that forage species selected by grazing heifers were not necessarily in proportions coinciding with the abundance of those species in the pasture. Therefore, the nutritive value of ingested forage may be of higher quality than the average nutritive value for the pasture based on relative plant abundance alone.

The time spent at certain daily grazing habits was largely a function of day length with variations caused by supplemental feeding and availability and growth stage of native forage.

Pacific Southwest Forest and Range Expt. Sta., FS, USDA, Berkeley, Calif.

Box, T. W. HERBAGE PRODUCTION IN FOUR RANGE PLANT COMMUNITIES IN SOUTH TEXAS. J. Range Mangt. 13: 72-76. 1960.

Herbage production was measured on a mesquite-buffalograss community, a chaparral-bristlegrass community, a bunchgrass-annual forbs community, and a pricklypear-short grass community in San Patricio County, Texas, by use of the Australian difference method. Total yearly production was very similar for the mesquite, chaparral, and bunchgrass communities but was somewhat lower in the pricklypear community. Two peaks in production occurred during the year, one March through June, the other September through December. Highest forb production occurred during the spring period in all communities, but it was approximately two months earlier in the bunchgrass community than in the others studied.

Contribution 40: Series A, Welder Wildlife Found., Sinton, Texas.

Ellison, L. INFLUENCE OF GRAZING ON PLANT SUCCESSION OF RANGELANDS. The Bot. Rev. 26: 1-78. 1960.

A review of the literature on the influence of grazing on the various types of grasses and shrubs in the United States.

Intermountain Forest and Range Expt. Sta., FS, USDA, Ogden, Utah.

Hyder, D. N., and Sneva, F. A. BITTERLICH'S PLOTLESS METHOD FOR SAMPLING BASAL GROUND COVER OF BUNCHGRASSES. J. Range Mangt. 13: 6-9. 1960.

Bitterlich's plotless method was tested as a method for sampling basal ground cover of bunchgrasses. A suitable acute angle (described by the plant: plot radius ratio of 1:10) was prepared by welding 1 1/2-inch angle iron and drilling a 1/4-inch hole at the vertex of the angle for pinning to selected sampling points. Basal ground cover about a point was determined by counting each plant that filled the angle. Each count gave 1 percent in basal ground cover.

Sample data obtained with the angle were compared with line interception data. When the methods were compared at equivalent sampling intensities, the angle required 1/9 as much time as line interception. Basal ground-cover estimates were 40 percent higher, differences among species were larger, and the order of species dominance was more consistent with the angle than with line interception.

The authors believe that it is expedient to employ an assistant to record data obtained by line interception but that an assistant is unnecessary when the angle is used.

The time advantage would probably have been much less if sampling had been conducted under sagebrush overstory, because the angle frame employed was cumbersome when brush was encountered.

CRD, ARS, USDA, Burner, Oreg.

Cook, C. W., and Gates, D. H. EFFECTS OF SITE AND SEASON ON OXALATE CONTENT OF HALOGETON. J. Range Mangt. 13: 97-101. 1960.

From August, 1953, to April, 1954, a study was conducted on salt dessert range in northwestern Utah to determine the effect of site and season upon the oxalate content of halogeton.

Trenches were dug in six vegetation types where halogeton was present. Root depth and lateral spread were traced along the faces of the trenches. Soil samples were collected from the exposed layers and analyzed for soluble salts.

Collections of halogeton were made from each vegetation type at various seasons during the 1953-54 fall and winter grazing season. These samples were separated into leaves and seeds, and stems and analyzed for soluble oxalates. Two seasonal collections were subjected to leaching treatments.

Significant differences in exchangeable sodium and base exchange capacity were found in soils from the various vegetation types. The soluble oxalate content of halogeton is not influenced by the sodium content of the soil when more than three milli-equivalents of exchangeable sodium per 100 grams of soil are present.

The soluble oxalates in halogeton are subject to leaching. Both leaching and shattering of seeds affect oxalate content of the plants. Shattering seed tends to increase oxalates in the remaining plant until mid-winter; thereafter, leaching tends to decrease the oxalate content. Lethal amounts still remain until mid-April, however.

Halogeton roots are concentrated in the surface soil, especially when subsoils have high salt content. However, despite this, a few roots extended downward as far as 40 inches when only five months of age.

Utah Agr. Expt. Sta., Logan, Utah.

Sharp, L. A., and Barr, W. F. PRELIMINARY INVESTIGATIONS OF HARVESTER ANTS ON SOUTHERN IDAHO RANGELANDS. J. Range Mangt. 13: 131-134. 1960.

The western harvester ant is one of the more important insects on the rangelands of the west.

Studies on the number and size of clearings made by the harvester ant at three locations in the Raft River Valley of southern Idaho are reported. Plots in the depleted saltsage location had three to four times as many clearings per acre as either the shadscale or saltsage plots. Yearly changes in the number of clearings was greatest in the depleted saltsage and least in the saltsage.

The largest clearings were found in the saltsage community and the smallest in the depleted saltsage community. Measurements were not taken in the shadscale plots. The total area occupied by ant clearings was approximately 3.5 and 5 to 8 percent at the saltsage and depleted saltsage locations respectfully.

A greater number of clearings as well as a greater total area cleared was found in the poor condition than in the good condition saltsage. Increased ant activity is thought to be a result rather than a cause of poor range condition.

Forest Wildlife and Range Expt. Sta., Agr. Expt. Sta., U. Idaho, Moscow, Idaho.

Kay, B. L. EFFECT OF FIRE ON SEEDED FORAGE SPECIES. J. Range Mangt. 13: 31-33. 1960.

Improved forage species used in reseeding California brush ranges are often burned in follow up brush control fires or by accident. The effect of burning on forage plants varies according to species, time of burning, location, condition of pasture, etc.

Hardinggrass in California appears to be very fire tolerant under the conditions tested. A seven year old stand of hardinggrass increased from 13 percent ground cover before burning to 16 percent ground cover the year following burning.

Rose clover was slightly reduced in density by burning. A large portion of the shattered rose clover seeds were blackened by fire. These would not germinate. However, sufficient undamaged seed remained to produce a satisfactory stand of rose clover.

Smilo in rocky areas did not burn well and was not affected by reburning. However, smilo plants growing in heavy fuel accumulations were all killed by fire.

Wheatgrasses were not damaged by burning at the end of the third growing season. The stand seemed to improve during the fourth growing season due to the rhizomes of intermediate and pubescent wheatgrass produced after burning.

U. Calif., Davis, Calif.

Plant Materials

Hancock, N. I., and Overton, J. R. BEHAVIOR AND ADAPTATION OF BALBO AND TETRA PETKUS RYE. Tenn. Agr. Expt. Sta. B. 307, 15 pp. 1960.

Rye is an important winter pasture plant in Tennessee. Balbo has been the leading variety of rye in this state since its introduction. It has rapid, erect growth in seedling stage resulting in earlier pasture and earlier seed maturity than other varieties. In fact, plants of Balbo are so responsive to warm spells in winter months that they change into the reproductive stage and are subject to killing unless grazed. Balbo has weak stems and may lodge. It has 14 chromosomes and is a diploid.

Tetra Petkus is a recent introduction in Tennessee. It has slow, prostrate growth in seedling stage resulting in later pasture and later maturity of seed than Balbo. It remains in vegetative stage longer and is less likely to be injured by spring freezes than Balbo. It has considerably stronger stems and is more resistant to lodging. It has larger and fewer seeds than Balbo so that yields of grain are about the same for both varieties. The plants of Tetra Petkus have 28 chromosomes and is a tetraploid.

Rye is cross pollinated and the seed yields of both varieties are adversely affected when planted near each other, because their cells have different chromosome numbers.

Growth rate of heads within the stems during early spring months will determine time when grazing should be discontinued, if seed harvest is contemplated.

U. Tenn., Agr. Expt. Sta., Knoxville, Tenn.

Washko, J. B. SOYBEAN VARIETIES FOR FORAGE AND GRAIN IN PENNSYLVANIA. Pa. Agr. Expt. Sta. B. 666, 9 pp. 1960.

Forage Production: (1) Forage yields in central and southeastern Pennsylvania varied with varietal maturity. Highest dry matter yields were obtained with varieties reaching the hay stage of maturity from September 8 to 10. (2) The two varieties, Perry and Wabash, were highest yielding at both University Park and Landisville over the 6-year period. At the former location, Perry produced 2.59 and Wabash 2.57 tons of dry matter per acre; at the latter location, yields averaged 2.93 and 2.91 tons per acre, respectively. (3) Among the mid-season varieties, Lincoln was most productive of forage. At University Park it produced 1.98 tons of hay per acre, and at Landisville 2.11 tons. (4) Of the early maturing varieties, Blackhawk was slightly better than Monroe and Hawkeye in forage production at University Park, where as at Landisville Hawkeye was slightly better than Blackhawk and Monroe over tons of hay per acre and at the latter location Hawkeye averaged 2.01 tons. And (5) in northern Pennsylvania, only minor differences were obtained between varieties in forage production. Early maturing Blackhawk, Monroe, and Lincoln tended to be higher in dry matter content at harvest than late varieties, such as Wabash or Black Wilson.

Grain Production: (1) As in the case of forage, grain production was related to varietal maturity, highest yields being obtained with the later maturing varieties. (2) At University Park, Blackhawk was slightly higher yielding than other varieties in the early maturity group. Yield differences, however, among the top four, Blackhawk, Chippewa, Earlyana and Monroe, were statistically non-significant. (3) In the mid-season maturity group at University Park, Adams and Lincoln were approximately equal in grain production. The four varieties, Adams, Lincoln, Harosoy, and Hawkeye, were comparable in yield, minor yield differences among these varieties being statistically non-significant. (4) At Landisville, Hawkeye was highest in grain production of the early varieties. (5) Lincoln was the most productive grain variety in the mid-season maturity group and Clark in the late maturity group at Landisville. (6) Protein content of grain for the various varieties also was related to maturity. In general, higher protein values were obtained in the early maturing varieties and lower protein values in the late maturing varieties. Protein contents of the seed ranged from 38.5 to 43.5 percent on a moisture-free basis. And (7) seed of the late maturing Clark variety was highest in oil content, 21.1 percent. Other varieties with 20 percent or more of oil were Blackhawk, Adams, Hawkeye, and Perry.

Pa. State U., Col. Agr., Agr. Expt. Sta., University Park, Pa.

Sumner, D. C., Goss, J. R., and Marble, V. L. GRASS SEED IN CALIFORNIA. Calif. Agr. Expt. Sta., Ext. Serv. C. 487, 18 pp. 1960.

This circular gives the general culture and care needed to raise grass seed commercially in California.

Growing grass seed has the following:

1. Advantages: (1) Production is not difficult, except for harvesting problems with some grasses; (2) given favorable climate, high yields, inexpensive water, and low production costs, one can obtain a profit on moderate acreage; (3) grass seed production fits well into a rotation system--the crop tends to improve the soil on which it is grown; and (4) additional income can be expected from the by-product--feed.

2. Disadvantages: (1) The crop requires considerable special attention, and the grower should be experienced in row crops, irrigation, and seed production; (2) the field should be kept free from weeds, mixtures, and off-types; (3) prices offered for grass

seed are more sensitive to supply and demand than most other crops, and supply and demand are greatly affected by the vagaries of climate; and (4) the grower must be observant, willing to experiment, and able to adjust recommended cultural practices to his own farming conditions.

Calif. Agr. Expt. Sta., Ext. Serv., Davis, Calif.

Ching, T. M., Taylor, H. L., and Rowell, P. T. CHANGE OF FORAGE SEED QUALITY UNDER DIFFERENT SIMULATED SHIPPING CONDITIONS. Agron. J. 52: 37-40. 1960.

The seed quality change of warehouse-stored lots of Alta fescue, chewings fescue, common ryegrass, crimson clover, Highland bentgrass, and sudangrass was observed at four combinations of humidity and temperature which simulated some shipping and temporary storage conditions. It was found that at 90° F. and 90% R.H. (relative humidity) all the 6 kinds of forage seeds deteriorated and gained a considerable amount of moisture within a few weeks time, while under conditions of 90° F. and 40% R.H. all the seed lots lost an appreciable quantity of moisture and their germinability was retained. Under conditions of 35° F. and 85% R.H. or 70° F. and 66% R.H. all the seed lots maintained viability for 10 weeks; however, slow decline of germinability and increasing of seed moisture were observed at the end of 6 months storage. Fresh seed lots and lots with high original germination withstood the adverse conditions longer than one-year-old seeds and seed lots with low quality.

Polyethylene bags of 6 mil in thickness preserved seed quality of undried forage seed lots studied, with the exception of sudangrass, even under the extremely adverse conditions.

Oreg. Agr. Expt. Sta., Corvallis, Oreg.

Hawk, V. B. BIRDSFOOT TREFOIL SEED PRODUCTION. U.S.D.A., S.C.S. TP-137, 12 pp. 1960.

Birdsfoot trefoil began to show promise as a useful perennial legume in the Midwest about 20 years ago. It maintains itself well on soils of low fertility and is particularly adapted to wet soils or those with poorly drained subsoil. Adequate production of cover and forage can, however, be obtained only by fertilizing and liming on soils low in plant nutrients. Birdsfoot trefoil is more drought resistant than red clover but is less hardy than alfalfa. The domestic strains, as represented by the Empire variety, are particularly resistant to close grazing and winter injury. The imported strains, such as French and Italian, are less winter hardy and are better adapted for hay production. Narrowleaf trefoil and big trefoil are distinct species with limited adaptation to mild climates.

Birdsfoot trefoil demonstrated its value for soil-conserving cover and forage on Class VI soils in the eastern two-thirds of Iowa in field plantings from 1941 to 1948. With increased interest in the legume, soil conservation district seed plots were established in Iowa from 1949 to 1953, to meet a pressing seed need.

Experiences in the production of birdsfoot trefoil seed in Iowa soil conservation districts are analyzed.

SCS, USDA, Inform. Div., Washington 25, D. C.

Vincent, C. L. ONION SEED PRODUCTION IN EASTERN WASHINGTON. Wash. Agr. Expt. Sta. B. 612, 14 pp. 1960.

Since no information had been published on growing onion seed in Washington, a project was developed to determine whether satisfactory yields of viable onion seed could be grown in the Palouse region without irrigation. From the experiments the authors made the following conclusions:

1. Onion seed of the Yellow Globe Danvers variety can be grown successfully without irrigation in the Palouse region of Washington if mother onion bulbs not less than 1 1/4 inches in diameter are planted not later than mid-April.

2. Bulb-to-seed plantings were used in the experiments at Pullman. This method is recommended for onion seed growing over the seed-to-seed method, as it permits some rogueing in the field and again when handling the onions in storage.
3. October (fall) planting of mother onion bulbs, though practiced in some areas of the West, is not recommended for the Palouse area.
4. In these studies weeds were not troublesome after the seedstalks began to form, and cultivation was stopped, as the seedstalks are easily broken from the plants.
5. Mother onion bulbs planted by mid-April were in full bloom by mid-July.
6. Onion seed heads were found to be ready to harvest, without reducing seed viability, when the secondary heads had turned from a dark green to green-gray. At that time the primary heads were opening, exposing black seed.
7. Seed was harvested in late August and early September each year from March-April plantings.
8. In over-all seed production there was no significant yield differences between mother bulbs 2 inches or more in diameter when the individual onions within a group size were planted the "width of an average bulb" to 3 inches apart in the row and with the rows 3 feet apart. Mother onion bulbs 2 to 3 inches in diameter produced significantly greater yields of cleaned onion seed per acre than bulbs less than 2 inches in diameter.
9. A 1 year's study indicates that onion rows spaced as close as 18" apart, without additional water being applied, will give significant seed yield increases over bulbs planted in rows 3 feet apart.
10. These studies show that yields of upwards to 700 to 800 pounds of Yellow Globe Danvers seed per acre can be obtained during an average year without additional water. With water and with closer spacings between rows even larger yields can be obtained.

Wash. Agr. Expt. Sta., Inst. Agr. Sci., Wash. State U., Pullman, Wash.

Woodlands

Leaf, A. L. FOREST SOILS: PHYSICAL, CHEMICAL AND ECOLOGICAL ASPECTS. Paper presented at Biol. Sci. Seminar Ser., Biol. Sci. Div. State U. Foresters, Syracuse U., Feb. 24, 1960. 12 pp. 1960.

Forest soils, though considered a specialized aspect of forestry, actually is a part of the broad field of soil science. The principles of soil science must be fully understood before soils information may be adequately applied to forestry use. Leaf presents a technical discussion of forest soil from a biological aspect.

State U. Col. Forestry, Syracuse U., Syracuse, N.Y.

Garland, L. E., Pierce, R. S., and Trimble, G. R., Jr. A SOIL SURVEY OF FOREST LAND. J. Soil and Water Conserv. 14: 199-204. 1959.

This report presents a modification of detailed soil surveying methods on farmlands for use in mapping extensive areas of woodland in the Northeast. One reason for this modification is that certain aspects of forest soil surveys, such as type of mapping unit and degree of subdivision of the soil factors of texture, drainage, and percent of land slope do not require mapping in as great detail as is used in mapping farmland.

On the other hand, information on such factors as aspect, position on slope, and exposure, which are not usually included in farmland soil surveys, are needed in surveys of forested areas to describe conditions affecting tree growth and watershed management. It is recognized that differences in these factors, while not reflected in morphological soil characteristics that can be identified in the field, do cause differences in soil-moisture relationships. In addition, there are temperature differences resulting from topographic factors. These differences influence evaporation and transpiration, and indirectly tree growth and streamflow, without producing noticeable soil differences.

Procedures for the Hubbard Brook survey are not set up as exact prototype procedures for forest land surveys in the Northeast. Objectives of the surveys may differ from one forest tract to another. The actual procedures and classification details must be tailored to the needs of the area in question and the intensity of management expected to be practiced.

Soil Correlator, SCS, USDA, Cornell U., Ithaca, N.Y.

Steinbrenner, E. C. A PORTABLE AIR PERMEAMETER FOR FOREST SOILS. Soil Sci. Soc. Amer. Proc. 23: 478-481. 1959.

Forest soil productivity studies brought out the need for a rapid and quantitative method to determine macroscopic pore space in the soil. To meet this need, a portable soil permeameter was developed that measures macroscopic pore space directly in the field.

The instrument consists of a steel cylinder with carrying harness, constant pressure regulator, toggle-valve, soil-tube, and pressure gauge. In operation, the tube is inserted in the soil, a constant air pressure delivered, and the resistance of the soil to this pressure read on the pressure gauge.

For calibration, 68 samples covering a wide range of soil porosities were obtained from soil pits in residual and glaciated soils of western Washington. For each of those samples, permeameter readings taken in the field were related to determination of volume of macroscopic pores drained by a pressure of 1/3 atm. From these calibration data, a dial-face reading directly in percent macroscopic pore space was designed for the peremeameter pressure gauge.

Data are presented that relate soil macroporosity, as determined by the permeameter, to growth of Douglas-fir seedlings on soils of recently-logged areas. Applications of this instrument to soil productivity studies are discussed.

Forestry Res. Cent., Weyerhaeuser Timber Co., Centralia, Wash.

Bolar, M. D. WOODLAND CONSERVATION. Soil Conserv. 25: 58-59. 1959.

In 1940 Arl Hildebrand of Prescott, Arkansas, was offered $300 for the timber on an 8 acre plot of dense pine growing on Class III land.

Using proper management and selective cutting he has sold $2,583 of timber from the plot in 17 years, and now has more standing timber than he had in 1940.

Not satisfied with the original 8 acres, Mr. Hildebrand has planted over 100,000 pine seedlings during the past 10 years. He proposes to commence thinning his pine trees when they reach pulp size, which they do when they are 10 to 11 years old.

SCS, USDA, Hope, Ark.

Larson, P. R. A PHYSIOLOGICAL CONSIDERATION OF THE SPRINGWOOD SUMMERWOOD TRANSITION IN RED PINE. Forest Sci. 6: 110-122. 1960.

The transition from the formation of springwood to summerwood in trees of the temperate regions has presented an intriguing problem to foresters and physiologists alike for many years.

The present study was based on the hypothesis that summerwood formation may be correlated with the cessation of terminal elongation and the setting of new buds through an auxin-mediated system. To test this hypothesis, the study was designed with a twofold objective: (1) To determine the relationship between the cessation of terminal elongation and the transition of springwood to summerwood; and (2) to determine the effect on growth-ring formation of exogenous applications of a growth hormone to decapitated seedlings.

Seedlings grown under long-day conditions continued to produce springwood-like cells for an extended period of time. Summerwood-like cells could be induced to form either by short-day treatment or by decapitation. When seedlings were transferred from short-day to long-day conditions, springwood-like cell production was resumed, but only in seedlings with an intact bud. Limited production of springwood-like cells was induced in decapitated, short-day seedlings by the exogenous application of IAA.

Based on the experimental evidence of this investigation, the original hypothesis may be restated in more specific terms: Large-diameter, springwood cells will be produced during the period of active elongation growth and high auxin synthesis. Narrow-diameter, summerwood cells will be produced following the cessation of terminal growth and the consequent reduction in auxin synthesis; a growth-inhibiting system may also become more prominently active at this time. Any factor that causes terminal elongation growth to begin prematurely or to cease will bring about a respective increase or decrease in cell diameter. The extent to which a change in terminal activity will register a concomitant change in xylem tracheid development will be dependent upon the intensity of the apical stimulus. Thus, a false ring originating from a "second flush" of growth may be evident only in the uppermost parts of the stem. The increase in summerwood cell wall thickness is due to a physiological process separate from that causing the decrease in cell diameter, although the two phenomena occur more or less simultaneously in normal summerwood development.

Lake States Forest Expt. Sta., FS, USDA, Rhinelander, Wisc.

Orlov, A. Y. OBSERVATIONS ON ABSORBING ROOTS OF SPRUCE (PICEA EXCELSA LINK) IN NATURAL CONDITIONS. Translated from Russian Botanicheskii zhurnal, U.S.S.R. 42(8): 1172-1181. 1957.

A method is described for studying the development of roots with the use of cover glasses and a binocular magnifier. This method makes it possible to conduct direct observations in the forest, without a substantial alteration of environmental conditions, on the growth dynamics of absorbing roots, the formation of absorbing terminals, changes associated with age, dying off processes, formation of mycelial coating, etc.

Direct observations, conducted in the course of two years on the formation and growth of individual absorbing roots, have indicated the absence of any rigid growth periodicity in the absorbing roots of spruce. Under favorable conditions of moisture and temperature, the growth of roots was kept up during the entire vegetative season.

The growth of absorbing roots is determined by environmental conditions rather than by any internal factors of development regulation. The dry season of 1955 (from July to September) caused stoppage or, at least, strong retardation of growth. The onset of growth in spring and its interruption in fall coincide approximately with periods when the temperature of the medium surrounding the roots is about 6° - 8° C in the daytime.

No growth of roots was detected during the winter of 1955-56.

The rate of growth of root terminals is rather slow: the average increase during the vegetative season of the biggest lateral appendages amounts to 0.01 - 0.03 mm per day; in the period of most rapid growth it goes up to 0.05 (occasionally to 0.10) mm; the average daily increment of the axis of root terminals for the vegetative season varies from 0.03 to 0.07 mm per day, the maximum being 0.15 mm per day.

Small extension roots are distinguished by a considerably more vigorous growth (up to 1.5 mm per day), and it is noteworthy that periods of rapid growth alternate with rest periods, the latter being characterized by browning of the root and suberization of some of its tissues.

With progressing age, a change takes place in the external appearance and in the anatomical structure of the absorbing roots. The young roots, initially light-colored, with transparent tissues of the primary cortex, turn brown (on account of the browning of the cells of the primary cortex - particularly their peripherial layers), and the degree of suberization of endothermis cells increases. The discoloration process is usually accomplished very rapidly; the light-colored zone moves forward in the wake of the growing tip of the rootlet, and elongates somewhat during the period of more intensive growth. Subsequently, the cells of the primary cortex and the fungal mycelium which is symbiotically associated with the root, die off. In this stage the ability of the root to take up nutrients is evidently greatly reduced. Externally, such roots are characterized by dark (black or dark-brown) coloring, reduced diameter (compared with the young roots), and a rugose surface.

Direct observations have shown that the absorbing terminals of spruce roots may be preserved for two vegetative seasons after their initiation; during that time dying off of terminals was recorded only in isolated instances, apparently due to accidental causes. In the great majority of absorbing rootlets no dying off of the primary cortex or the mycelial coating could be detected in the course of two years. In the case of some rootlets, particularly in the basal parts of the axis of root terminals, the primary cortex dies off rather quickly, occasionally within a single vegetative season. In isolated cases, absorbing roots with a dead cortex remain alive for a considerable length of time and may persist, without dying off, throughout two vegetative seasons.

(Price $0.50)
Off. Tech. Services, U.S. Dept. Commerce, Washington 25, D.C.

Cooper, C. F. CHANGES IN VEGETATION, STRUCTURE, AND GROWTH OF SOUTHWESTERN PINE FORESTS SINCE WHITE SETTLEMENT. Ecol. Monog. 30: 129-164. 1960.

The late settlement of the region makes northern Arizona particularly suitable for a study of vegetation change resulting from man's use of the land. Changes in the ponderosa pine forests of southwestern United States have been studied through analysis of the historical evidence and of the structure of the present forest stand.

Reports of early visitors indicate that the forest was originally more open than it is today. Dense thickets of young ponderosa pine have covered much of the region in the last half century. Accompanying the increase in young pines has been a decrease in grass cover and a shift in the botanical composition of the herbaceous vegetation. Accelerated erosion has removed the surface soil layers and induced formation of gullies in some places.

Long term climatic changes do not appear to be a major factor contributing to these changes, nor do the effects of wild animals. Some of the change in herbaceous vegetation is the result of excessive use by domestic livestock, but much is directly due to the increasing density of the pine overstory. Livestock have initiated some of the increase in pine reproduction by reducing grass competition and by exposing a mineral seedbed that makes seedling establishment easier.

The most important change brought about by the white man has been the virtual exclusion of fire from the forests of the Southwest. Under natural conditions, light surface fires, set by lightning or by Indians, burned through all parts of the pine forest at regular intervals of 3 to 10 years. These fires acted as natural thinning agents and reduced surplus fuel. The reduction of inflammable grass by grazing animals, and an intensive fire prevention program have largely eliminated fire from the woods. The major cause of the present excess of pine reproduction is exclusion of fire.

Since competition is mostly for water, not light, the normal suppression pattern characteristic of humid forests does not occur in southwestern ponderosa pine. Small trees continue to grow at a constant slow rate, and suppressed and intermediate trees in the aggregate play a greater role than is usually attributed to them. Natural mortality is low in stands unaffected by fire.

Growth of potential crop trees is a linear function of the logarithm of stand density. Stem area growth of an individual tree is directly proportional to the weight of the current year's needles. Height of dominant saplings is related to stocking and age of stands as well as to site index.

It is doubtful if, after 40 years of protection, use of prescribed fire can now reverse the trend toward excessively dense pine thickets. Silvicultural possibilities of planned fire can probably only be realized in young stands originating after timber harvest. Some practical and economic means must be found for thinning young pine stands and for reducing the amount of hazardous fuel. If fire is to be this means, modifications will have to be made in the present method of marking trees for harvest, which is rapidly converting the even-aged groups into a true all-aged forest. In general, small trees in and beneath an even-aged group are not only not desirable, but are often a hindrance in managed forests.

The ponderosa pine forests of the Southwest evolved under the influence of natural fires. Man's attempted exclusion of fire and introduction of livestock has induced marked changes in the vegetation of the region.

Dept. Botany, Duke U., Durham, N.C.

Shaner, B. A. SITE PREPARATION FOR REFORESTATION, USING A D-7 CRAWLER TRACTOR WITH ANGLE DOZER. J. Forestry 57: 915-916. 1959.

The furrowing of sodded and brush lands by D-7 caterpillar with angle dozer is a workable and economical method of site preparation for reforestation in some particular areas. Results indicate furrowing effectively knocks back sod and most other competition for at least 2 years in the furrow, giving the planted seedling an opportunity to become well established.

Timber Dept., Natl. Plywood Corp., Roseburg, Oreg.

Western Conservation Journal HE THINS PINE WITH A BULLDOZER. West. Conserv. J. 17(1): 32-33, 40-41. 1960.

A tree farmer near Mitchell, Oregon, is experimenting with an idea for thinning dense pine thickets that may revolutionize pine management.

John Collins has several hundred acres of scrawney, stagnated pine trees so dense that their growth was practically stopped. To get the most thinning the quickest way at the lowest cost, he has gone to work on his woods with a bulldozer.

By removing about 75% of the growth in the thickets by a bulldozer, Mr. Collins reports that his "released" trees are growing 4 or 5 times faster than before. The bulldozer technique costs about $4 per acre while power saw thinning costs about $35 per acre.

By thinning in the late fall months he reduces the danger of insects getting into the down trees. Beside giving the remaining trees more light and moisture, the trails create a firebreak effect and they can be used for skid trails when the timber matures and is ready for harvesting.

No address given.

Teeguarden, D. E., and Gordon, D. T. A PRECOMMERCIAL THINNING IN PONDEROSA AND JEFFREY PINE. J. Forestry 57: 900-904. 1959.

In 1955 a precommercial thinning was begun in ponderosa pine seedling and sapling stands on the Blacks Mountain Experimental Forest. Continued in 1957, a total of 519.4 acres have been covered and more than 22,000 trees released on 44.8 acres. The thinning, combining mechanical spacing and low thinning methods, was aimed at releasing selected trees at an average spacing of 9 feet to improve growth in overdense stands. Some mistletoe control work was done in conjunction with the thinning.

Two types of portable, mechanical power saws were used at an average cost per released tree of $0.01. Labor costs, including charges for stringing working areas and saw maintenance and repair, averaged $0.08 per released tree in 1955 and $0.09 in 1957. The total cost for both machines and labor thus was $0.09 to $0.10 per tree. Gross acre costs ranged from $1.97 to $6.26 and averaged $4.19. Net acre costs ranged from $23.45 to $84.86 and averaged $48.61.

Production rates ranged from 11.7 to 45.6 man-hours per net acre, and averaged 24.9 man-hours, or about three man-days. On a gross acre basis, 2.0 man-hours were required. Converted to a tree basis, thinning required an average of 2.8 man-minutes per released tree. These figures include all time involved in stringing, thinning, saw repair and maintenance, and supervision. Considering thinning time only, the average time required per gross acre was 1.3 man-hours; per net acre, 13.0 man-hours; and per tree, 1.6 man-minutes.

U. Calif. Sch. Forestry, Berkeley, Calif.

Alexander, R. A. THINNING LODGEPOLE PINE IN THE CENTRAL ROCKY MOUNTAINS. J. Forestry 58: 99-104. 1960.

Studies were initiated between 1924 and 1934 on four national forests in Colorado and Wyoming to determine spacings for thinning small lodgepole pine. Twenty-two plots in stagnated and overstocked 35- to 78-year-old stands were selected for study. All plots, except one in each block, were thinned to different intensities. The remaining plot was left unthinned as a control. Plots were remeasured in 1955.

Diameter growth in all age groups was simulated by the intensities of thinning tested. It was greatest on the most heavily thinned plots. Basal area increment per acre was also stimulated in most treatments. The greatest basal area growth followed heavy thinning in the older and larger stands and light thinning in the younger stands.

Regression analysis showed that diameter growth was greatest at the minimum density tested for all diameter classes within the range of available data, and that there is little advantage from the standpoint of total wood production in reserving more than 600 trees per acre in stands averaging 1.0 and 2.0 inches in diameter at the time of thinning. Total growth approaches a maximum at that density and mortality increases rapidly at greater densities. When initial diameter is 5.0 inches, total growth approached a maximum with as few as 300 stems per acre.

With a market for small-sized material and only one precommercial thinning possible, thinning to 600, 500, and 400 trees per acre is recommended when initial diameters are 1.0 to 2.0, 3.0, and 4.0 inches, respectively. For stands averaging 5.0 inches or more in diameter, a light commercial thinning leaving 300 trees to the acre may be possible in the future. If only one precommercial thinning can be made, and no market is available for subsawlog-sized material, a reserve of 300 trees per acre is recommended for stands averaging 1.0 to 5.0 inches in diameter.

Rocky Mountain Forest and Range Expt. Sta., FS, USDA, Fort Collins, Colo.

Conover, D. F., and Ralston, R. A. RESULTS OF CROP-TREE THINNING AND PRUNING IN NORTHERN HARDWOOD SAPLINGS AFTER NINETEEN YEARS. J. Forestry 57: 551-557. 1959.

Noncommercial crop tree thinnings were made in a sapling northern hardwood stands in 1938 and 1946. Thinning was done by removing all trees within two different fixed radii around selected crop trees. By 1957, after 16 years, board foot volume growth showed a definite advantage for the plots thinned to the widest crop tree thinning radius.

The authors summarize their work as follows: (1) Board foot volume in the heaviest thinning averaged 1,369 board feet per acre compared to 846 board feet on the check plots. (2) The total volume in cords after 16 years was greatest on the unthinned plots. However, 54 percent of it was in noncrop trees while 86 percent of the total volume on the heavier thinning was in crop trees. (3) Thinning increased diameter growth and decreased mortality of crop trees. Trees on the heavier thinning made the best height growth. (4) Dominant sugar maple remained dominant or codominant regardless of treatment. The chances of trees selected from the codominant and intermediate crown classes to become final crop trees were improved by thinning, but, even so, intermediate and suppressed trees were generally poor choices. On the heaviest thinning, 46 percent of the intermediates were dead or suppressed after 16 years. (5) Epicormic branching was general after the second pruning and thinning in 1946 on all species except white ash. Sprouting also occurred on the unthinned plots but was about a third less on dominant and codominant trees than on those in the unthinned plots. In 1957, after 16 years, most of the epicormic branches were gone except in intermediate and suppressed trees. And (6) forks below 25 feet were much more frequent in the thinned plots. In the heavier thinning 65 percent of the elm forked below that height compared to 38 percent on the check plots.

It is too early to evaluate fully the long-term results of either the increased growth of selected crop trees stimulated by thinning or the negative effects on quality. It is evident that great care is necessary in marking young stands in the developmental stages because of considerations such as forking, natural pruning, epicormic branching, and growth response of trees of different species and size classes.

Lake States Forest Expt. Sta., FS, USDA, Wausau, Wisc.

Leaf, A. L. NURSERY SOIL AND SEEDLING ANALYSES AS A FOUNDATION FOR NURSERY SOIL MANAGEMENT. Paper presented at Northwest Nurserymans Conference, Essex Junction, Vt., Sept. 10, 1959, 9 pp. 1959.

Soil and/or seedling analysis are in themselves of relatively minor importance to nurserymen, but are of prime concern as tools of immense practical usefulness. Soil and stock analyses are important to determine nursery soil fertility and thus to determine proper soil management to maintain a high production of high quality seedlings over a long period. These practices may then be modified by nurserymen to best fit their particular facilities and allowable expenditures.

With millions of seedlings being grown annually in northeastern nurseries for reforestation purposes, the need, economically and otherwise, for the best possible cultural techniques is axiomatic. If we assume one acre of a nursery produces over two million three year old seedlings worth more than $4.00 per thousand, then one acre is worth more than $10,000 in three years, or a thirty acre nursery grosses over $100,000 per year. Due to this high economic value of forest nurseries, the use of intensive soil management practices including various soil amendments and commercial fertilizer salts has been proven and is becoming common practice.

The importance of producing nursery seedlings of high quality cannot be over emphasized. Parallel to this is the importance of good nursery soil management for high quality planting stock. Actually, the main objective of any forest nursery is to achieve the production of vigorous and disease-free planting stock, and thus to reduce to a minimum the failure or eventual deterioration of plantations. One thing worse than the lack of planting stock to a field forester is planting stock of poor quality that will result in eventual deterioration and failure of plantations.

State U. Col. Forestry, Syracuse U., Syracuse, N. Y.

Hosner, J. F., Dickson, R. E., and Kahler, L. STORING LOBLOLLY PINE SEED IN POLYETHYLENE BAGS AS A SUBSTITUTE FOR STRATIFICATION. J. Forestry 57: 495-496. 1959.

Based upon this study and practices at two different nurseries, storing small samples of moistened seed of loblolly pine in polyethylene bags for 60 days shows promise as a substitute for stratification in sand as a pregermination treatment to break internal seed dormancy. However, additional tests with different species and different quantities of seed are needed before it can be recommended without reservations on a more universal basis.

Southern Ill. U., Carbondale, Ill.

Lotti, T., and LeGrande, W. P. LOBLOLLY PINE SEED PRODUCTION AND SEEDLING CROPS IN THE LOWER COASTAL PLAIN OF SOUTH CAROLINA. J. Forestry 57: 580-581. 1959.

From this study we have some evidence that many loblolly pine stands in the South Carolina Coastal Plain probably could be adequately regenerated without the benefit of residual seed trees, if cut after seedfall. Generally the risk of failure would increase with the depth of the litter and the density of the understory hardwoods and brush. This risk could be reduced with a program of prescribed burning in the years prior to harvest. Any additional cultural measures could be prescribed as needed.

Southeastern Forest Expt. Sta., FS, USDA, Charleston, S. C.

Dickson, A., Leaf, A. L., and Hosner, J. F. QUALITY APPRAISAL OF WHITE SPRUCE AND WHITE PINE SEEDLING STOCK IN NURSERIES. Forestry Chron. 36(1): 10-13. 1960.

Total seedling weight, shoot weight, and root weight in grams on an oven dry basis, root collar diameter in millimeters, and height in centimeters were used to develop an integrated index of seedling quality in white pine.

State U. Col. Forestry, Syracuse U., Syracuse, N. Y.

Slocum, G. K., and Maki, T. E. EXPOSURE OF LONGLEAF PINE PLANTING STOCK. J. Forestry 57: 825-827. 1959.

One-year-old longleaf pine planting stock was exposed to direct sunlight in two tests in 1954 and 1955 at Raleigh, North Carolina. Half the stock had the roots puddled in creamy clay mud prior to exposure; the remainder was handled according to normal practice, leaving the roots bare. Average temperatures during exposure ranged from 73° F. to 80° F. The seedlings were planted in randomized replicated blocks in prepared soil in the nursery and the trend of survival was tallied during the first growing season.

The following conclusions appear warranted on the basis of these tests: (1) Large stock (averaging 1/4 inch in groundline diameter and weighing over three gr. when oven-dry) is clearly superior to small stock (averaging 1/8 to 3/16 inch in diameter and weighing less than 1 1/2 gr. when oven-dry) in withstanding direct exposure. (2) Almost any duration of exposure is probably harmful, but with larger stock and clay-puddled roots, first-year survival remains acceptable up to half-hour or longer exposures. Even after three hours, survival of large stock averaged more than fifty percent at the end of the first growing season. And (3) clay-puddling of longleaf pine roots after lifting and grading appears to be a simple and inexpensive guard against injury from chance exposure during planting.

Sch. Forestry, N. C. State Col., Raleigh, N. C.

Miller, W. E., and Heikkenen, H. J. THE RELATIVE SUSCEPTIBILITY OF EIGHT PINE SPECIES TO EUROPEAN PINE SHOOT MOTH ATTACK IN MICHIGAN. J. Forestry 57: 912-914. 1959.

Observations were made on eight species of pine to determine their relative susceptibility to European pine shoot moth attack in Michigan.

The method used was to compare ratios of number of insects to number of shoots found on each pine species near the end of the shoot moth generation.

On the basis of these ratios, Virginia, pitch, jack, and eastern white pines were rated as having low susceptibility, their insect-shoot ratios averaging less than 0.002. Ponderosa, Austrian, and Scotch pines were rated as medium in susceptibility with mean insect-shoot ratios between 0.03 and 0.07. Red pine was rated as high in susceptibility; its insect-shoot ratio being 0.2, the highest of the study.

In Lower Michigan, and perhaps in other areas where the shoot moth is a severe pest of red pine, damage could probably be reduced by the planting of otherwise suitable species from the low and medium susceptibility groups defined by this study.

Lake States Forest Expt. Sta., FS, USDA, East Lansing, Mich.

Cook, D. B. THE HATCHET AND OILCAN TECHNIQUE FOR THE APPLICATION OF SODIUM ARSENITE. J. Forestry 57: 845-847. 1959.

The Hatchet and Oilcan Technique (the tree is chopped with a hatchet and sodium arsenite is squirted into the cut or cuts with a pressure oiler) provides a safe, quick, simple, sure, and cheap way to eliminate unwanted trees, both hardwood and softwood. It requires a minimum of tools, no special equipment, and no special skill. There is nothing to break, burst, or get out of order. Anyone who can skillfully and vigorously handle a hatchet and is able to walk through the woods can do it. The risk to workers and to wildlife is reduced to the absolute minimum. The results are readily visible within two weeks. There will be no build-up of harmful insects or fungi. The cost is so low, in both chemicals and labor, that the use of this technique can extend our silvicultural dollar at least fivefold. Considering the immensity of the thinning task confronting foresters, this is an approach to the reduction of stand density that merits most careful consideration and widespread use.

Cooxrox Forest, Albany, N. Y.

Arend, J. L. AIRPLANE APPLICATION OF HERBICIDES FOR RELEASING CONIFERS. J. Forestry 57: 738-749. 1959.

The application of herbicides by aircraft for timber stand improvement by freeing conifers from undesirable hardwoods and brush is a relatively new technique in forestry operations. The development and use of silvicide spraying by aircraft for these purposes are described in this paper.

Since 1950, the use of aircraft to apply selective herbicides for the release of conifers from less desirable hardwoods and brush has been tried with varying degrees of success in most forest regions of the United States. Its use to date has been most successful in the Lake States.

The general spray prescription for most extensive use is 1 to 2 pounds acid equivalent of 2, 4, 5-T in 2 to 5 gallons of oil-water carrier per acre. The quantity of herbicide and carrier (water versus oil) needs to be varied for each brush condition.

The spray prescription should be applied after the hardwoods are fully leafed out and the new growth of the conifers has started to harden off. This is 4 to 6 weeks after full-leaf development of the hardwoods, depending on the forest region.

No general detrimental effects to wildlife have been reported from aerial spray release operations from this study. Where the hardwoods to be controlled produce wildlife food, such as acorns, unsprayed strips can be considered.

Lakes States Forest Expt. Sta., FS, USDA, East Lansing, Mich.

Davis, J. R. LOW-VOLATILE 2, 4, 5-T EFFECTIVE AS BASAL SPRAY. J. Forestry 57: 851. 1959.

A low-volatile ester of 2, 4, 5-T was just as good as a more dangerous high-volatile ester in killing sweetgum (Liquidambar styraciflua) in east Texas. The low-volatile ester was 2, 4, 5-T (propylene glycol butyl ether ester) while the high-volatile ester was 2, 4, 5-T (pentyl or amyl ester).

The herbicides were applied on 240 small trees during May in two concentrations as a basal spray. The results in terms of percent of treated stems killed are presented in Table 1.

Table 1.--Stem Kill by Varying Treatments

Basal spray solution	Proportion apparently dead: After one growing season	Proportion apparently dead: After two growing seasons
	Percent	Percent
4 lbs. low-volatile 2,4,5-T acid per 20 gals. diesel oil	75.0	96.7
4 lbs. high-volatile 2,4,5-T acid per 20 gals. diesel oil	56.7	90.0
2 lbs. low-volatile 2,4,5-T acid per 20 gals. diesel oil	45.0	86.7
2 lbs. high-volatile 2,4,5-T acid per 20 gals. diesel oil	51.7	83.3

Southern Forest Expt. Sta., FS, USDA, Nacogdoches, Tex.

Peevy, F. A. SOIL APPLICATION OF CHEMICALS FOR CONTROL OF SOUTHERN UPLAND HARDWOODS. Forests and People 10(1): 24-25, 37. 1960.

Both fenuron and monuron killed oaks growing on upland sites when applied in late winter or spring as soil injection treatments or when broadcast on the ground surface. These herbicides were effective at rates of 1/2 to 1 gram of active material per inch of trunk diameter. Fenuron was more effective than monuron for controlling oaks, and its residue seemed less damaging to pine after 2 growing seasons. Pines were injured if their roots were present in the area of application. These herbicides were effective when applied as a finely ground powdered material or as pellets. The cost of chemical and labor is approximately 1/2 cent per inch of trunk diameter for applying 2 grams of fenuron or monuron for each 4 inches of trunk diameter as a soil-surface treatment around base of trees. 2,4,5-T was more effective when applied as a basal stem treatment to the lower 16 inches of the trunk than when applied as a soil-injection treatment.

CRD, ARS, USDA, Alexandria, La.

Leaf, A. L. RECENT DEVELOPMENTS IN THE USE OF FERTILIZERS IN FORESTRY. Paper presented at N. Y. Section. Soc. Amer. Foresters, Syracuse, N. Y. Jan. 29, 1959, 4 pp. 1959.

A review of the literature on recent developments in the use of fertilizers in Forestry.

State U. Col. Forestry, Syracuse U., Syracuse, N.Y.

Leaf, A. L., and Wilde, S. A. DECOMPOSITION PRODUCTS OF SLOUGHED ROOT TISSUES PROMOTE RELEASE OF AVAILABLE NUTRIENTS. U. Wisc. Forestry Res. Notes 49, 2 pp. 1959.

It has long been noted that forest trees have much greater capacity to utilize nutrients from unweathered minerals than do agricultural crops. In recent time, the high efficiency of tree roots to extract nutrient elements was attributed to the action of mycorrhizal fungi as well as to the chelating influence of the sloughings of feeding roots and mycotrophic organs.

To verify this assumption, observations were made of the effect of dead tissues of red pine roots on the release of available potassium from unweathered biotite, KMgFe-mica, containing 6.8 percent of total potassium.

The biotite alone released 19.0 mgm. of water soluble and exchangeable potassium or 5.5 percent of the total potassium present in this mineral. The root sloughings yielded 3.1 mgm. of potassium. The mixture of biotite and sloughings released 127.3 mgm. Thus, the organic matter was responsible for liberation of 105.2 mgm. potassium from biotite, or 30.9 percent of the total potassium content of the mineral.

It is most probable that the weathering of alumino-silicate minerals in contact with root sloughings is chiefly due to the effect of organic compounds chelating or complexing iron and some other metallic cations, a process leading to the destruction of the mineral structure. The results convincingly demonstrate the enormous capacity of tree roots to disrupt the structure of unweathered alumino-silicate minerals and thereby convert nutrient elements into available form.

The observed relationship strongly suggests the possibility of considerable economy, as well as stabilization of nutrient content of nursery soils, through a replacement of soluble potash fertilizers by micaceous schists, gneiss, syenite, potassium feldspar, and other potash bearing minerals.

Wisc. Conserv. Dept. and U. Wisc., Madison, Wisc.

Leaf, A. L. RECENT PUBLICATIONS ON TREE FERTILIZATION. N. Y. State Arborists Assoc. Shade Tree Notes 76, 8 pp. 1959.

A paper on the review of the literature on tree fertilization presented at the New York State Arborists Annual Meeting in Ithaca, N. Y., on January 13, 1958.

State U. Col. Forestry, Syracuse U., Syracuse, N. Y.

Zahner, R. FERTILIZER TRIALS WITH LOBLOLLY PINE IN SOUTHERN ARKANSAS. J. Forestry 57: 812-815. 1959.

In the spring of 1954 six fertilizer treatments were replicated nine times in 4- to 8-year-old loblolly pine plantations in southern Arkansas on Boswell sl, Myatt fsl, and Norfork sl. Fertilizers were applied only once. Chemical analysis of soil and foliage samples indicated the mineral uptake by trees in each treatment.

Height growth was not affected by any treatment tested but diameter growth was stimulated for two growing seasons by nitrogen fertilizer. Three hundred pounds of N per acre gave better growth than 100 pounds the second year, but not the first. The addition of phosphorus, potassium, or minor elements did not significantly increase growth over nitrogen alone.

Foliar analysis showed that N, P, and K were picked up from fertilizers, the N in proportion to the quantity applied. The nitrogen content of fertilized needles diminished to a level with controls after three years.

Total five-year diameter growth increase due to fertilizer was about 10 percent for a single application of 100 pounds of N per acre. The more elaborate fertilizers did not significantly further increase growth over the total period.

Sch. Nat. Resources, U. Mich., Ann Arbor, Mich.

Steinbrenner, E. C., Duffield, J. W., and Campbell, R. K. INCREASED CONE PRODUCTION OF YOUNG DOUGLAS-FIR FOLLOWING NITROGEN AND PHOSPHORUS FERTILIZATION. J. Forestry 58: 105-110. 1960.

Applications of ammonium nitrate and superphosphate were broadcast on 20 quarter-acre plots laid out in a 20-year old stand of Douglas-fir in southwestern Washington. Levels of application were 100 and 200 pounds per acre of N and of P_2O_5 in four combinations and an unfertilized control. First-year seed production was 1.2 pounds per acre on unfertilized control plots; 4.5 pounds on plots with 100 pounds application of each nutrient; and 10.3 pounds of seed per acre on plots with 200 pounds application of each nutrient. Treatments were repeated. In the second spring following the initial fertilizer application, 37 percent of the unfertilized trees produced flowers; 56 percent of those with 100 pounds per acre of each nutrient; and 75 percent of those treated with 200 pounds per acre of nitrogen and phosphate produced flowers. The greatest response in growth and cone production was shown to be attributable to the nitrogen applications although increases occurred with an application of phosphorus in conjunction with the higher levels of nitrogen.

Weyerhaeuser Co., Forestry Res. Cent., Centralia, Wash.

Clark, L. MERRY CHRISTMAS--YEAR-ROUND JOB: CHRISTMAS TREES IMPORTANT PART OF OHIO FARMER'S CONSERVATION PROGRAM. Soil Conserv. 25: 101-102. 1959.

Planting a quarter million trees in 10 years is a big job on any farm. That is what Roy Masterson of Sayre, Ohio, has done and he is continuing to plant about 25,000 a year. He likes Christmas trees, found them a solution to his erosion problem, and has developed a good woodland business.

Masterson has developed both a retail and wholesale market for Christmas trees. He operates three large Christmas tree lots in Columbus, Ohio, and sells thousands on the stump. He supervises any cutting done on the farm so that a good timber stand will remain. He markets pulpwood during the winter.

Masterson is following a good conservation program on all his woodland fields. Improvement cuttings used for pulpwood and Christmas trees, provide some income each year.

"It is extremely important," Masterson said, "to have good roadways through the pine plantations. These serve as firebreaks and let firetrucks and spray equipment into the area. They also provide a way to haul out timber products. We spray for European pine shoot moth and tip moth repeating the treatment when new infestion is noticed."

Masterson clears brush and sprays stumps with brush killer a year before he starts planting trees. Grass and small brush must be controlled where it is a problem. This is done with a rotary mower several times during the growing season. Many trees to be harvested for Christmas sales are shaped and pruned in late May or early June. Some of them can be sold that year but others need additional shaping the following year.

SCS, USDA, Somerset, Ohio.

Voigt, G. K. DISTRIBUTION OF RAINFALL UNDER FOREST STANDS. Forest Sci. 6: 2-10. 1960.

Rainfall distribution patterns under forest covers of red pine, hemlock, and beech were investigated. Soil moisture observations showed that a considerable portion of the water which fell on the canopy was concentrated by the foliage, branches, and stem, and eventually released to the soil in a relatively narrow band around the base of the tree.

There were indications that the water flowing down the stem tended to follow the larger roots into the soil. When the magnitude of stemflow was calculated on the basis of the absorption area, it was found that the soil at the base of the average red pine tree received about one-fifth of the amount which fell in the open, soil under hemlock received the same amount of rainfall as the open area, and soil under beech received about two and one-half times the amount falling on the open area.

Water recovery values from trunk segments of the three species indicated that bark texture may offer a partial explanation for the stemflow differences. Red pine bark absorbed considerably more water than beech.

Further observations on red pine indicated that much of the water concentrated by the foliage and branches fell in a diffuse zone around the stem rather than flowing down the outer bark surface. Presumably this was due to the curled bark plates that caused the water to drop rather than flow.

Yale Sch. Forestry, New Haven, Conn.

Fruit and Nut Crops

Hill, R. G., Jr. RED RASPBERRY GROWTH AND YIELD AS AFFECTED BY SOIL MANAGEMENT; NITROGEN FERTILIZATION; AND TRAINING SYSTEMS. Ohio Agr. Expt. Sta. Res. B. 857, 31 pp. 1960.

The effect of three different cultural practices upon the growth and yield of the red raspberry were studied at Wooster, Ohio, during the 1951-54 seasons. These practices, soil management, severity of dormant pruning, and rates of nitrogen fertilization, were compared on the basis of yield, berry size and quality, cane growth, and leaf characteristics. The results of this study warrant the following conclusions:

1. The different cultural practices considered were, under the conditions of this study, independent of each other in their effect upon growth, yield, and the quality of the berry produced.
2. Mulch was superior to cultivation as a soil management practice. Mulched plants not only produced superior growth and yield, but larger berries.
3. Moderate heading of the dormant canes was followed without markedly effecting the crop. The actual amount of cane to be removed should be determined on the basis of the relative vigor of the raspberry plantings.
4. Trellising did not increase yields, but did serve to assure against crop loss due to wind and rain damage and to facilitate work in the planting.
5. The actual rate of nitrogen fertilization was not as important as the maintenance of proper level of nitrogen within the plant. The best indication of the nitrogen status of the planting was foliar nitrogen level. For best growth and yield the foliar nitrogen content in non bearing shoots in midsummer appeared to be within the range of 2.9-3.2 percent on a dry weight basis.
6. Leaf color in the red raspberry was directly related to the foliar nitrogen content. As the nitrogen content increased the green color became more intense.

7. Differences in soil management and pruning practices resulted in changes in berry quality of experimental interest. These changes were such; however, that it was concluded that growers could follow those practices most likely to result in maximum yields without fear of affecting the acceptability of the berries.

Ohio Agr. Expt. Sta., Wooster, Ohio.

Carlson, R. F., Moulton, J. E., and Rai, G. S. FIELD CONTROL OF STRAWBERRY RUNNERS IN THE FALL WITH MALEIC HYDRAZIDE. Mich. Agr. Expt. Sta. Q. B. 42: 622-627. 1960.

Maleic hydrazide used at 1, 2, and 3 pounds per acre when four to six runners per square foot were established the first week in September reduced the number of late formed unproductive runners on both Robinson and Paymaster varieties. The chemical was applied in 50 gallons of water per acre in order to get uniform wetting of the strawberry foliage.

No significant increase in yields were obtained in the first picking from any of the treatments with maleic hydrazide. However, fruit in the first picking from treated areas appeared larger, and the plant foliage was more vigorous and somewhat darker green than on unsprayed plants.

In these tests the Robinson and Paymaster varieties tolerated maleic hydrazide at 1 and 2 pounds per acre and showed only slight chlorosis on runner tips at the 3-pound rate. One pound per acre was sufficient to inhibit runners on a sandy soil, whereas it required 2 pounds on the clay loam soil.

Purslane that had germinated in late August was controlled with 2 and 3 pounds per acre of maleic hydrazide.

NOTE--Maleic hydrazide has been cleared for use on strawberries to inhibit excess runners in the fall of the first year strawberry planting. No residue (NR) of the chemical can be found in the strawberry when used according to directions on the manufacturer's label. Do not use maleic hydrazide on everbearing varieties.

Mich. State U., Agr. Expt. Sta., East Lansing, Mich.

Brown, E. E., Spurlock, H. C., and Thomas, W. H. LABOR EFFICIENCY AND DAMAGE CONTROL IN HARVESTING PEACHES. S. C. Agr. Expt. Sta. B. 475, 32 pp. 1960.

This report covers work conducted under a broad program of research. The overall objectives were: (1) To determine the amount of physical damage and the economic loss occurring at each step or function in harvesting and handling of fresh peaches; (2) to test alternative methods which might be economically feasible and advisable; (3) to measure labor requirements for certain functions; and (4) to develop methods of increasing labor efficiency. This report covers the first two phases--tree to the packing-house--of the overall study. The specific objectives of this part of the study were to determine: (1) The effects of various types of picking containers upon peach damage and labor efficiency during picking and emptying; (2) labor efficiency in picking, emptying, loading, and transporting peaches from tree to the packing-house using present methods and equipment; (3) the extent of physical damage incurred at each step during the harvesting and handling of peaches; and (4) alternative methods of harvesting and handling peaches in order to decrease damage and/or increase labor efficiency.

S. C. Agr. Expt. Sta., Clemson Agr. Col., Clemson, S. C.

Levin, J. H., Gaston, H. P., Hedden, S. L., and Whittenberger, R. T. MECHANIZING THE HARVEST OF RED TART CHERRIES. Mich. Agr. Expt. Sta. Q. B. 42: 656-658. 1960.

In 1956 research was initiated to develop equipment and methods for harvesting red tart cherries that would reduce the number of workers required and lower picking costs.

During the 1956, 1957, and 1958 seasons, various types of shaking and collecting equipment and methods were tried. During the 1959 season, the best combinations of equipment (a boom-type shaker and six different designs for collecting units) were used in harvesting approximately 3,000 trees and 6,000 lugs of cherries in six orchards. Time, motion, and cost studies were kept on the harvesting of 511 trees and 1,102 lugs of fruit.

On the average, the equipment used separated 95 percent of the cherries. Most of the fruit left on the trees lacked size, color, and maturity.

The grade of unsorted mechanically harvested cherries varied from 79 to 95 percent U.S. No. 1. These results show that acceptable grades can be obtained when care and proper equipment are used. Mechanical harvesting in conjunction with proper water handling resulted in the best quality.

Total mechanical harvesting costs varied from 1/2 cent to over 2 1/2 cents per pound depending on the size of the crop and the rate at which the work was done. Under the conditions existing in many orchards, mechanical harvesting will enable seven men to do the work of 33 handpickers and reduce harvesting costs by one half. The equipment and methods used proved satisfactory.

The success of a mechanical harvesting operation depends on such factors as age and structure of the tree, cultural practices, equipment used, handling methods, and supervision.

Mich. State U., Agr. Expt. Sta., East Lansing, Mich.

Field Crops

Cartwright, W. B., Caldwell, R. M., and Compton, L. E. RESPONSES OF RESISTANT AND SUSCEPTIBLE WHEATS TO HESSIAN FLY ATTACK. Agron. J. 51: 529-531. 1959.

Larvae of the hessian fly (Phytophaga destructor Say) cause the nearly complete stunting of the second and subsequent leaves of susceptible winter wheat varieties. In highly resistant winter wheats only slight stunting of the second leaf occurs and the third leaf develops normally. In moderately resistant varieties a severe initial stunting of the second leaf occurs, but, later, elongation is resumed and the third leaf develops normally.

Infested susceptible plants develop a deeper green color than do uninfested plants. The most resistant varieties maintain the normal light green color of uninfested plants.

Larvae congregate at the base of the infested seedling plant in an area 10 mm. above the fourth node. In susceptible varieties they remain in this position and develop to maturity.

Larvae on the most resistant variety, Durum P.I. 94587, die on the fourth on fifth day after hatching and are then carried upward beyond the overlying sheath of the first leaf. In the moderately resistant variety W38, a few larvae may live during the elongation of the second leaf sheath and form small puparia in a completely exposed position above the first leaf sheath, although usually they drop to the ground as immature larvae.

The continued elongation of leaf sheaths of resistant varieties is obviously detrimental to the completion of the life cycle of the hessian fly.

ARS, USDA and Purdue U., Agr. Expt. Sta., Lafayette, Ind.

Pickard, G. E., and Bateman, H. P. EXPERIMENTS IN HARVESTING DWARF CORN. Agr. Engin. 40: 732-735, 745. 1959.

Dwarf corn appeals to many farmers and engineers as a possible means of getting away from the corn picker with its high harvesting losses and its injury hazards. Very short corn that could be combined with a regular grain header offers greater convenience, lower investment, and probably a further reduction in harvesting losses. In addition, dwarf corn hybrids have shown a remarkable resistance to ear droppage and to root and stalk lodging that can often make a worth-while difference in the amount of corn recovered.

From the results of tests with picking and snapping machines in harvesting dwarf hybrids, it appears necessary to devise means to prevent excessive shelling of the very low ears. To make picking easier, a dwarf that has more uniform ear height is needed.

The good standability of dwarf hybrids helps to reduce harvesting losses, particularly late in the season.

A cutoff harvesting system is especially effective for harvesting dwarf corn. When a grain header with reel is used to harvest dwarf corn, it appears desirable to: (1) Use tilted reel bats; (2) use a reel about 45 in. in diameter; and (3) set the reel over the cutterbar with the slats passing about 14 in. above it.

In ridged (cultivated) corn, ear losses are excessive; but on flat, uncultivated ground, performance may be acceptable. Topping does not appear to improve combining of dwarfs, at least at late maturity.

U. Ill., Urbana, Ill.

Reichmen, G. A., Grunes, D. L., Carlson, C. W., and Alessi, J. N AND P COMPOSITION AND YIELD OF CORN AS AFFECTED BY FERTILIZATION. Agron. J. 51: 575-578. 1959.

A study was made of the effect of N and P fertilization on yield and nutrient composition of corn plants grown under irrigation. The relationships between yield and plant nutrient composition were also evaluated. These data were collected from an experiment in North Dakota, using hybrid Nodak 301 corn during the years 1953 through 1957. The N and P analyses were determined on the corn grain and the corn stover sampled at harvest time, and on leaves selected at the time of pollination (Aug. 6-12).

In the presence of added P, the yield of forage and grain was increased by applied N for rates up to 80 pounds of N per acre. In the presence of added N, P also increased production. Both N and P percentages in corn leaves, grain, and stover were increased by fertilization.

The N and P percentages in leaves sampled at pollination were highly correlated with the yields and with the total nutrient uptake values at harvest. Partial regression analysis showed that leaf N was the dominant indicator of yield, but that leaf P was also important. The N and P percentages in the leaves were found to be positively correlated.

SWCRD, ARS, USDA, Mandan, N. Dak.

Webb, J. R., and Pesek, J. T., Jr. AN EVALUATION OF PHOSPHORUS FERTILIZERS VARYING IN WATER SOLUBILITY: II. BROADCAST APPLICATIONS FOR CORN. Soil Sci. Soc. Amer. Proc. 23: 381-384. 1959.

Sixteen field experiments were conducted, in which two or more phosphorus fertilizers differing in water solubility were compared in broadcast applications for corn. The tests involved rates of 20 to 80 pounds of available P_2O_5 per acre, and were located on soil types which tested low in available P and had a pH range from 5.5 to 7.1.

Increasing the rates of applied P_2O_5 increased the P content of corn leaf samples taken at silking time, but the degree of water solubility of the P significantly influenced leaf P levels in only 1 of 11 experiments sampled. Grain yields were also increased by P_2O_5 rates but were not significantly affected by the sources of P at any of the test sites. Highly water-insoluble sources tended to be slightly less effective in a few of the experiments.

The general conclusion was that on the soils included in the study the degree of water solubility of the P was not an important factor in determining the effectiveness of fertilizers broadcast and plowed under for corn.

Iowa Agr. and Home Econ. Expt. Sta., Ames, Iowa.

Fulton, J. M., and Findlay, W. I. THE NUTRIENT COMPOSITION OF HYBRID CORN AS INFLUENCED BY FERTILIZATION: I. THE NITROGEN PERCENTAGE IN LEAF AND GRAIN. Canad. J. Soil Sci. 40: 42-48. 1960.

In field experiments on a sandy loam and a clay soil in 2 consecutive years, the yield of grain and percentage of nitrogen in ear shoot leaf and in the grain increased with increasing rates of nitrogen fertilization. The change in nitrogen percentage was greater for the leaf than for the grain and correlation between yield and nitrogen content was better for leaf samples than for grain samples. The relation between nitrogen content for the ear shoot leaf and yield was a straight line when rate of nitrogen fertilization was the only nutrient variable influencing yield. In this case, there was no evidence of luxury consumption or a critical level of nitrogen. However, when yield was limited by lack of phosphorus, luxury consumption of nitrogen did occur. The influence of applied nitrogen fertilizer on leaf nitrogen percentage was greater on the sandy loam than on the clay soil in spite of the fact that nitrogen percentage of the ear shoot leaf from the unfertilized plots was similar.

Canada Dept. Agr., Harrow, Ontario, Canada.

Parker, D. T., and Burrows, W. C. ROOT AND STALK ROT IN CORN AS AFFECTED BY FERTILIZER AND TILLAGE TREATMENT. Agron. J. 51: 414-417. 1959.

A severe outbreak of root and stalk rot of corn was found in experimental plots where tillage systems and levels of nitrogen and potassium fertility for production of corn were being compared. The relationships between tillage, fertility, and incidence of disease may be summarized as follows: (1) Tillage practice where crop residue was left on the soil surface was associated with decreased incidence of the disease; (2) high nitrogen fertility level markedly increased incidence of root and stalk rot; (3) the higher levels of potassium fertility had a small but significant effect in decreasing incidence of infection; (4) nitrogen/potassium ratio in leaf tissue was directly related to incidence of infection primarily as a result of the effect of nitrogen fertilization; (5) critically low levels of nitrogen would have been required to afford any control of the disease; (6) delayed growth and maturation of corn occurred with low nitrogen fertility, crop residue on the soil surface, and low incidence of disease; and (7) corn yield was markedly reduced by root and stalk rot when plants died of the disease before the ears were fully developed.

SWCRD, ARS, USDA, Ames, Iowa.

Raynor, T. COTTON GROWING IN PAHRUMP VALLEY. Soil Conserv. 24: 263-265. 1959.

From windblown, dusty acreages where a few years ago the new desert soils of the Pahrump Valley produced a bale or less of cotton per acre, most farmers are now harvesting two bales or more. Cotton yields have been greatly improved for most of the growers in this valley west of Las Vegas, Nev. A total of 5,488 bales, or an average of 1.96 bales per acre, were tallied up for the valley-wide harvest in 1958.

You can credit this cotton output to the farmers' good land use efforts. They made the scientific and practical know-how gained from years of pioneering this crop on the valley desert lands pay off.

Good weather, a switch to a new cotton variety, and improved farm machinery helped. But a great part of the increase came from soil building and soil and water conservation practices.

A new cotton variety, Acala 1517C, has been tried and looks very promising. It is earlier maturing and seems well adapted to this climate. Acala 442 was formerly the only variety used. Both varieties have been grown the past year, but in general the 1517C is favored. Some of the improved conservation practices that are being adopted are: crop rotation, subsoiling, increased fertilizer application, and conservation irrigation methods, along with better pest control and proper timing of planting and irrigations.

Tests made in the beginning stages of development revealed that penetration of irrigation water into most of the soils was slow. Until water penetration can be improved through deep rooted soil-improving crops, subsoiling has been found helpful in getting water down to the root zone.

SCS, USDA, Las Vegas, Nev.

Scarsbrook, C. E., Bennett, O. L., and Pearson, R. W. THE INTERACTION OF NITROGEN AND MOISTURE ON COTTON YIELDS AND OTHER CHARACTERISTICS. Agron. J. 51: 718-721. 1959.

Cotton was grown with nitrogen rates of 0, 60, 120, and 240 pounds per acre at 3 moisture levels during 1956 and 1957 at Thorsby, Alabama. The nitrogen content, height, maturity, boll weights, boll rot, and yield of the plants were measured.

The highest moisture and nitrogen levels produced the largest yield, 1,794 pounds of lint cotton. Nitrogen increased the efficiency of water utilization. At the highest moisture level, 1 acre-inch of water produced only 29 pounds of lint without added nitrogen but resulted in 57 pounds of lint where 240 pounds of nitrogen was added.

There was a direct relationship between the nitrogen content of the plants in late July and the eventual yield when moisture was ample. There was no relationship on non-irrigated plots where moisture was often deficient. Nitrogen content of the plants varied directly with nitrogen applications at all moisture levels, but the higher the moisture the greater the nitrogen uptake.

The combination of high rates of nitrogen and moisture decreased the lint percentage, increased boll rot, boll weight, and lodging, and delayed maturity of cotton.

Ala. Polytech. Inst., Auburn, Ala.

Anderson, O. E., and Webster, R. H. THE AVAILABILITY OF SULFUR IN NORFOLK LOAMY SAND AND LEADVALE SILT LOAM AS MEASURED BY COTTON GROWTH. Agron. J. 51: 675-677. 1959.

A sharp contrast between the sulfur supplying power of 2 cotton producing soils in Georgia was shown by growing cotton for 5 years on soils which received 0, 4, 8, 16, and 32 pounds of sulfur per acre applied annually. The heavier soil, a Leadvale sil, contained a high sulfate content in the upper 12 inches. On this soil no response to added sulfur was obtained. The lighter soil, Norfolk ls, contained less than 1 p.p.m. extractable sulfate-S in the upper 12 inches, but from that point downward, sulfur accumulated, reaching a maximum at the 30- to 36-inch layer. On this soil, no measurable yield reduction occurred for four years when cotton was grown without applied sulfur, but by the fifth year yields were drastically reduced.

In view of the large acreage of cotton grown on soils similar to the sandy soil in this study and in view of the present trend toward fertilizers containing increasingly smaller amounts of sulfur, these findings have implications of considerable importance.

Ga. Agr. Expt. Sta., Experiment, Ga.

Amin, J. V., and Joham, H. E. GROWTH OF COTTON AS INFLUENCED BY LOW SUBSTRATE MOLYBDENUM. Soil Sci. 89: 101-107. 1960.

Cotton plants were grown for two generations in purified nutrient solutions. Mo was supplied at the rate of 1 p.p.m. to one group and withheld from a second series. In the advanced fruiting stage of the first-generation experiment, chlorotic growth was observed on some of the minus Mo plants, and in the second-generation experiment quantitative differences in growth were obtained between the two series. No deficiency was indicated by increased nitrate and reduced alcohol-soluble amino acid content. The present work suggests that the Mo content of the embryos is important from the standpoint of a critical level below which normal absorption and possibly assimilation of this element is greatly retarded.

Tex. Agr. Expt. Sta., College Station, Tex.

McCants, C. B., Skogley, E. O., and Woltz, W. G. INFLUENCE OF CERTAIN SOIL FUMIGATION TREATMENTS ON THE RESPONSE OF TOBACCO TO AMMONIUM AND NITRATE FORMS OF NITROGEN. Soil Sci. Soc. Amer. Proc. 23: 466-469. 1959.

Fertilizer mixtures in which the nitrogen was all-ammonium, all-nitrate or equal parts ammonium and nitrate were applied in conjunction with the following soil fumigation treatments: not-fumigaged, Dowfume W-85 (ethylene dibromide), Shell DD (dichloropropene and dichloropropane), and methyl bromide. Data were obtained on the effect of fumigation and N treatments on: (1) The relative levels of ammonium and nitrate N in the soil during the growing season; (2) the ammonium and halogen content in the tobacco leaf at certain stages of growth; and (3) the yield and certain properties of the cured tobacco leaf.

Methyl bromide and Shell DD reduced nitrification to a greater degree than did Dowfume W-85. Three weeks after transplanting, the ammonium N and halogen contents in tobacco leaves from the ammonium N treatment were higher than from the nitrate N treatment on soil fumigated with Shell DD or methyl bromide, but no different for the Dowfume W-85 or not-fumigated treatments.

The yield and quality index of tobacco from the Shell DD and methyl bromide fumigation treatments increased with increasing percentage of the total N applied in the nitrate form. With Dowfume W-85, the highest yield was from the mixture of ammonium and nitrate N. There were no differences in yield or quality among N treatments on soil not-fumigated. For all fumigation treatments, the percentage N and percentage nicotine in the cured leaf were higher where ammonium N than where nitrate N was applied.

N. C. Agr. Expt. Sta., Raleigh, N. C.

Hong, G. B., and Schuylenborgh, J. van. LEAF COMPOSITION OF LOWLAND RICE AND SUGAR CANE AS AN INDICATOR OF THEIR PERFORMANCE. Netherlands J. Agr. Sci. 7: 110-117. 1959.

Nutrient uptake studies were conducted with lowland rice and sugar cane as dependent on time. Foliar composition, characterized by the element-concentration ratios, was taken as an index of their nutritive state. It appeared that the ratios of the major elements remain fairly constant in the whole growing season and that these are indicative for crop yield and crop quality. It is therefore possible to analyse both crops in a very early stage of development; this is advantageous as no choice of which leaf has to be analysed is needed. The whole above ground part can be sampled without the danger of obtaining too voluminous a sample. The possibility of an early analysis allow to correct for an eventually inadequate nutritive state of the plant in the same growing season.

The mobilities of the major elements could be arranged in following order of decreasing mobility: $PO_4 > N > K$ for the rice plant, and $N > PO_4 > K$ for the sugar cane plant.

U. Indonesia, Bogor, Indonesia.

Ogata, G., and Caldwell, A. C. NITRATE CONTENT OF SOILS AND NITROGEN CONTENT OF OAT PLANTS AS AFFECTED BY RATES OF LIMING. Agron. J. 52: 65-68. 1960.

Lime brought about moderate increases in the amount of nitrate nitrogen in an acid Skyberg sil under fallow. Moderate rates (4 tons per acre) were as effective as heavy rates (16 tons per acre). Fallowing for 2 years resulted in the accumulation of up to 1,000 pounds of nitrate per acre in the top 2 feet of soil. Nitrate in a successively cropped soil amounted to only a few pounds per acre. Consistent, but seldom statistically significant, increases in the nitrogen content of oats were brought about by lime applications.

Sci. J. Ser. Paper 4097, Minn. Agr. Expt. Sta., St. Paul, Minn.

Frey, K. J. YIELD COMPONENTS IN OATS. II. THE EFFECT OF NITROGEN FERTILIZATION. Agron. J. 51: 605-608. 1959.

The average yield increases of 10 oat varieties ranged from 50 to 65% when 20, 40, or 80 pounds of nitrogen were applied per acre. The yield increase was due to nitrogen stimulating the production of more heads per plant and more seeds per head. The other yield component, weight per seed, was depressed slightly but not significantly by increasing rates of nitrogen fertilization.

Certain varieties responded to nitrogen fertilization differentially. Marion produced high relative grain yield increases because both number of heads per plant and number of seeds per head were stimulated, whereas Clintland responded only in number of seeds per head. In contrast, Bond variety produced little response to nitrogen fertilization in either relative grain yield or any of the yield components.

By determining the effect of nitrogen fertilization upon the different yield components it may be possible to predict which strains from hybrid origin would be suited to low nitrogen levels and which to high nitrogen levels.

Iowa Agr. Expt. Sta., Ames, Iowa.

Loomis, R. S., Brickey, J. H., Broadbent, F. E., and Worker, G. F., Jr. COMPARISONS OF NITROGEN SOURCE MATERIALS FOR MIDSEASON FERTILIZATION OF SUGAR BEETS. Agron. J. 52: 97-101. 1960.

Because sugar beets require a period of nitrogen deficiency just before harvest in order to attain a high sucrose percentage, the crop presents unique midseason nitrogen fertilization problems. Various nitrogen source materials were compared in field tests on two California soils (Holtville cl and Yolo l) by employing tissue and soil analyses and plant growth data as measures of their efficiency.

Nitrate carriers proved to be more suitable than ammonium carriers for late-season or emergency applications. Differences in plant response were interpreted through soil and tissue analyses.

U. Calif., Davis, Calif.

Werkhoven, C. H. E., and Miller, M. H. ABSORPTION OF FERTILIZER PHOSPHORUS BY SUGAR BEETS AS INFLUENCED BY PLACEMENT OF PHOSPHORUS AND NITROGEN. Canad. J. Soil Sci. 40: 49-58. 1960.

A greenhouse study was conducted to determine the effects of placement of phosphorus and nitrogen on absorption of fertilizer phosphorus by sugar beets on Perth cl soil. Seven placements of P-32-labelled concentrated superphosphate combined with three nitrogen treatments--None, 20 lb. N. mixed with the soil, and 20 lb. N. applied with the phosphorus--were used. The nitrogen source was ammonium nitrate. The phosphorus placements included three band placements, two applications mixed with 2 inches of soil at the 3-5 inch depth with and without a starter, and two applications mixed with 2 inches of soil at the 0-2 inch depth with and without a starter.

The placement of nitrogen had a greater influence on the uptake of fertilizer phosphorus than did the placement of phosphorus. Nitrogen applied with the phosphorus generally resulted in greater uptake of fertilizer phosphorus than did nitrogen mixed with the soil. The nitrogen was more effective when the phosphorus was banded than when it was mixed with a volume of soil 2 inches deep. When no nitrogen was added or when nitrogen was mixed with the soil, a shallow band placement or the applications mixed with 2 inches of soil were equally effective in supplying phosphorus to the plant, and were superior to either a deep band or a mixed application with a starter. However, when nitrogen was added with the phosphorus, the shallow and deep bands were equally effective and were superior to the mixed application with or without a starter.

Ontario Agr. Col., Guelph, Ontario, Canada.

De, R., and Singh, R. EFFECT OF MICRONUTRIENT ELEMENTS ON GROWTH, YIELD, AND CHEMICAL COMPOSITION OF SUGAR CANE. Soil Sci. 89: 97-100. 1960.

Field experiments were conducted for two years to study the effect of soil and foliar application of iron, copper, manganese, zinc, boron, and a combination of these elements, on the growth, yield, chemical composition, and juice quality of sugar cane.

Foliar application of the elements was found to be better utilized by the plants than soil application.

Iron applied to the foliage in a 0.5 percent solution of ferrous sulphate increased the growth of the crop significantly. Though the yield of millable cane was not significantly enhanced by this treatment, the extent of increase was of the order of 14.9

percent in 1954-55 and 12.8 percent in 1955-56. Increased growth and yield of sugar cane under this treatment were found to be positively correlated with greater nitrogen uptake and more hexose synthesis in leaves.

Juice quality of sugar cane was significantly improved by foliar application of boron as boric acid in a 0.3 percent solution. The maturity of cane was enhanced and the sugar percentage in juice increased by 2.5 units. Boron application also resulted in greater sucrose synthesis in leaves.

Sugarcane Res. Sta., Jullundur, Punjab, India.

Withee, L. V., and Carlson, C. W. FOLIAR AND SOIL APPLICATIONS OF IRON COMPOUNDS TO CONTROL IRON CHLOROSIS OF GRAIN SORGHUM. Agron. J. 51: 474-476. 1959.

Soil applications of iron compounds to correct iron deficiency chlorosis of grain sorghum in southwestern Kansas were somewhat effective but economically impractical. Spraying chlorotic grain sorghum with 3 sprays of 4% ferrous sulfate was an effective method of improving the yield of grain. Thirty gallons per acre of the spray solution were required.

Kans. State U., Agr. Expt. Sta., Manhattan, Kans.

Vegetable Crops

Ware, L. M., and Johnson, W. A. EVALUATION OF EFFECTS OF PRACTICES AFFECTING YIELD OF IRISH POTATOES IN ALABAMA. Amer. Potato J. 36: 179-184. 1959.

There are a number of general conclusions of a practical nature that might be made from these studies:

1. Each of the good practices, that is, the highest rate of fertilizer, the closer spacing, a larger size seed, and use of irrigation and organic materials, gave significant increases over the 3-year period as well as for each of the separate years.
2. Each good practice not only increased yields but increased the value of other good practices. Organic materials over the 3-year period increased yields 30.9 bags per acre. Irrigation increased yields 51.1 bags. Organic materials and irrigation, when used jointly, increased the yield 112.8 bags, or 38.7 bags more than both of the practices used separately.
3. The omission of any good practice when all other good practices are used may easily jeopardize the effectiveness of all of the other good practices. In 1956, a year of extremely low rainfall, the yield was 212.5 bags per acre where all good practices were used. When irrigation was omitted, only 12.9 bags per acre were produced even though 2,400 pounds of fertilizer, organic materials, 12-inch spacing, and 1 1/2-ounce seed were used. In 1955, when tops were killed by a freeze, yields were 237.7 bags of No. 1 potatoes with all good practices used; where organic material was omitted, it was only 112.3 bushels or where irrigation was omitted, it was only 121 bags.

Ala. Polytech. Inst., Auburn, Ala.

Tavernetti, J. R., and Baghott, K. G. A STUDY OF POTATO HARVESTING AT TULELAKE, CALIFORNIA. Amer. Potato J. 37: 34-37. 1960.

There was practically no difference in the amount of serious injury between hand and mechanical harvesting by the time the potatoes were in storage. There was less injury in the field with the hand method, but rough handling of the stubs in loading onto the trucks and in emptying at the storage shed caused a considerable increase. More damage than necessary occurred with both methods in conveying the potatoes into the storage bins. Reducing the drop into the conveyor hopper, better padding in the hopper, and keeping the drop from the discharge end to a minimum, would help to reduce this damage.

U. Calif., Davis, Calif.

Akeley, R. V. EFFECTS OF SEED-CUTTING DATES ON YIELDS OF VARIOUS POTATO VARIETIES. Amer. Potato J. 36: 147-153. 1959.

The effects of dates of seed cutting on the yields and stands of 3 potato varieties were tested in 1955 in Maine and of 8 varieties in 1956 in Maine, Wisconsin, Connecticut, New Hampshire, and South Carolina.

A preliminary test using 3 varieties was conducted in Maine in 1955. Eighty-eight days elapsed between the first and the last date of seed cutting. Differences in yields of seed cut on different dates and the interaction of cutting dates and varieties were not significant.

Similar results were obtained in the 1956 tests which included seed of 8 varieties cut, suberized, and stored in Maine prior to planting in 5 States. Differences in yields between dates of seed cutting at monthly intervals were not significant in Maine, Wisconsin, Connecticut, and New Hampshire although 243 days elapsed between the earliest and the latest cutting dates. In South Carolina a difference of 158 days between dates of seed cutting likewise had no effect on yields with the exception of Sebago which produced a lower yield when its seed was freshly cut on February 15.

CRD, ARS, USDA, Beltsville, Md.

O'Keefe, R. B., and Werner, H. O. POTATO PRODUCTION IN DRYLAND ROTATIONS IN WESTERN NEBRASKA THROUGHOUT A TWENTY-THREE YEAR PERIOD. Amer. Potato J. 36: 325-332. 1959.

Rotation studies with potatoes were conducted under dryland conditions at the Box Butte Experiment Farm in western Nebraska from 1931 through 1953. One of the major objectives of these rotations was to ascertain the best dryland rotation practices with respect to the production of potatoes. Production and factors affecting it during the dry cycle of 1931-40 were compared with those of the 1941-53 period of above normal precipitation.

The amount and depth of soil moisture stored at planting time and the amount and distribution of seasonal rainfall were by far the most important factors affecting potato yield and quality. Highest yields were obtained when the soil was filled to field carrying capacity to a depth of 5 feet at planting time followed by 2 to 3 inches of effective rainfall in August or early September. Approximately 5 to 6 inches of preplanting stored soil moisture was necessary to produce yields that warranted growing the crop. Summer fallowing preceding potatoes consistently provided all the soil moisture the soil could retain and resulted in commercially adequate yields.

Cropping sequence effects on total potato yields were associated with the amount and distribution of precipitation and stored soil moisture following the harvest of the crop and prior to planting potatoes. Lowest yields were produced with continuous cropping of potatoes. Lower yields were produced when potatoes followed corn or small grain than after field beans. Highest yields were consistently produced after summer fallowing.

Length of rotation (3 or 5 years) had little effect on yields and quality of potatoes, but during the 1941-53 period, yields from the 5 year rotations tended to be higher than from the 3 year rotations.

Yield of U.S. No. 1 potatoes followed the same trend as total yields. Scabby and "off-type" tubers were the major grade defects, whose incidence was influenced more by seasonal conditions than by rotations.

U. Nebr., Lincoln, Nebr.

Bishop, J. C., and Wright, D. N. THE EFFECT OF SIZE AND SPACING OF SEED PIECES ON THE YIELD AND GRADE OF WHITE ROSE POTATOES IN KERN COUNTY, CALIFORNIA. Amer. Potato J. 36: 235-240. 1959.

Both total yield and, to a somewhat lesser degree, yield of U.S. No. 1 tubers were increased by increasing the quantity of seed potatoes planted per acre--through closer spacing and/or larger seed pieces. The rate of yield increase declined with each increment of seed potatoes. Planting more than approximately 16 sacks of seed potatoes per acre did not increase the yield sufficiently to justify the greater expense.

Large seed pieces spaced at 7 1/2-inch intervals produced the highest proportion of small tubers. Potato size was determined more by spacing than by seed piece size.

The yield of "rough" tubers (misshapen, growth-cracked, and second-growth tubers) was slightly and inconsistently affected by size or spacing of seed pieces.

Table 1.--Total yield of White Rose potatoes with varied seed piece size and spacing

Seed piece		Seed potatoes required (100-lb. sacks/A)	Total yield (100-lb. sacks per acre)					
Size (oz.)	Spacing in row (inches)		1952	1953	1954	1955	Average 4 years 1952-55	Average 3 years 1953-55
1	15	8 1/6	247	296	328	262	283	295
1	7 1/2	16 1/3	276	346	340	289	312	325
1 1/2	15	12 1/4	--	327	305	290	--	307
1 1/2	7 1/2	24 1/2	--	355	353	304	--	337
2	15	16 1/3	294	337	350	307	322	331
2	7 1/2	32 2/3	331	369	371	336	351	359
Difference required for significance at odds of 19:1			17	26	n.s.	19		

Table 2.--Effect of seed piece size and spacing on yield of smooth, well-shaped tubers over 1 7/8 inches in diameter (U.S. No. 1)

Seed piece		Seed potatoes required (100-lb. sacks/A)	U.S. No. 1 yield (100-lb. sacks per acre)					
Size (oz.)	Spacing in row (inches)		1952	1953	1954	1955	Average 4 years 1952-55	Average 3 years 1953-55
1	15	8 1/6	226	256	270	227	245	251
1	7 1/2	16 1/3	248	314	269	252	270	278
1 1/2	15	12 1/4	--	293	240	254	--	262
1 1/2	7 1/2	24 1/2	--	311	273	259	--	281
2	15	16 1/3	254	296	288	273	278	286
2	7 1/2	32 2/3	280	315	266	274	284	285
Difference required for significance at odds of 19:1			24	33	n.s.	23		

U. Calif., Davis, Calif.

Houghland, G. V. C., and Akeley, R. V. EFFECTS OF SEED SPACING AND FERTILIZER RATE ON FIELD PERFORMANCES OF POTATO VARIETIES AND ON FINANCIAL RETURNS. Amer. Potato J. 36: 227-234. 1959.

Experience of potato breeders and others has shown that it is usually desirable to obtain as much information as possible on the field performance of newly-named varieties before they are released for commercial production.

The varieties Saco, Kennebec, Katahdin, and Merrimack were selected for the present experiment, and these were planted at 3 different spacing distances with 4 rates of fertilizer application. The Katahdin variety, because of its well-established growth characteristics, was included as a control. The treatment effects on yield, tuber size, and number of tubers per hill were determined and, in addition, financial returns from the differential use of seed and fertilizer were calculated.

Table 1.--Net financial returns per acre[1] from 4 potato varieties fertilized and spaced differently

Spacing and fertilizer rate per acre	Returns per acre from variety indicated			
	Saco	Kennebec	Katahdin	Merrimack
	Dollars	Dollars	Dollars	Dollars
6-inch spacing:				
1000 pounds......	486	416	351	282
1200 pounds......	507	424	379	300
1400 pounds......	570	475	437	352
1600 pounds......	526	490	408	338
Average........	522	451	394	318
9-inch spacing:				
1000 pounds......	453	368	327	291
1200 pounds......	477	438	356	332
1400 pounds......	526	487	364	327
1600 pounds......	515	456	393	340
Average........	493	437	360	323
12-inch spacing:				
1000 pounds......	453	401	327	270
1200 pounds......	438	433	347	334
1400 pounds......	478	477	375	341
1600 pounds......	503	441	378	330
Average........	468	438	357	319

[1] Gross returns minus the cost of seed and fertilizer. Seed was estimated at $2.50 per cwt; 10-15-15 fertilizer at $80.00 per ton; and tablestock at $1.57 per cwt.

CRD, ARS, USDA, Beltsville, Md.

Yamaguchi, M., Perdue, J. W., and MacGillivray, J. H. NUTRIENT COMPOSITION OF WHITE ROSE POTATOES DURING GROWTH AND AFTER STORAGE. Amer. Potato J. 37: 73-76. 1960.

Potatoes were analyzed for nine food nutrients and energy as affected by maturity and storage period. As tubers approached maturity in the field, sugar and vitamin C decreased, and other nutrients increased. The principal change in storage was a loss in vitamin C.

Table 1.--Nutritive value of White Rose potatoes grown at Davis at different stages of growth.

Harvest date	Days after planting	Av. Wt. per tuber	Water	Total sugars	Starch	Protein	Energy Kg	Minerals			Vitamins			
								Ca	Fe	P	C	B_1	B_2	Niacin
		Grams	Grams	Grams	Grams	Grams	Calories	Mg	Mg	Mg	Mg	Mg	Mg	Mg
		Per 100 grams edible portion												
June 7	60	50	85.3	0.75	8.12	1.90	43.7	13	3.1	37	38	0.064	0.019	0.57
June 21	75	115	85.0	0.88	8.92	1.73	46.7	10	1.3	32	43	0.072	0.019	0.72
July 5	90	140	84.3	0.98	10.45	1.86	53.7	12	2.0	37	42	0.093	0.016	0.68
July 19*	105	155	81.8	0.28	12.61	2.10	60.7	11	1.8	45	48	0.106	0.024	0.62
Aug. 8	120	175	81.6	0.18	11.52	2.09	56.0	12	1.9	45	39	0.101	0.023	0.67
Aug. 17	135	192	80.8	0.25	11.86	2.37	58.7	14	2.0	53	36	0.117	0.025	0.66

* Usual shipping maturity for Kern County potatoes.

Table 2.--Nutritive value of mature White Rose potatoes grown and stored at Davis, California.

	Water	Total sugars	Starch	Protein	Energy Kg	Minerals			Vitamins			
						Ca	Fe	P	C	B_1	B_2	Niacin
	Grams	Grams	Grams	Grams	Calories	Mg	Mg	Mg	Mg	Mg	Mg	Mg
	Per 100 grams edible portion											
At harvest 8/17/49.........	81	0.25	11.9	2.4	59	14	2.0	53	36	0.12	0.025	0.66
41° F. storage:												
3 weeks.................	81	0.94	10.7	2.4	57	17	1.6	46	26	0.13	0.025	0.70
6 weeks.................	80	1.23	11.0	2.4	59	13	1.8	49	19	0.13	0.032	0.70
9 weeks.................	81	0.94	--	2.3	--	11	1.6	46	17	0.13	0.033	0.64
12 weeks................	80	0.87	10.5	2.4	56	13	1.7	46	16	0.12	0.034	0.62
18 weeks................	81	0.73	9.7	2.7	53	12	1.9	49	11	0.12	0.027	0.60
24 weeks................	81	0.63	11.3	2.6	59	11	1.9	54	10	0.11	0.031	0.56
30 weeks................	81	0.52	10.1	2.7	54	12	2.6	54	10	0.13	0.027	0.56
50° F. storage:												
18 weeks................	80	0.16	10.2	2.6	53	14	1.7	52	12	0.13	0.027	0.60
24 weeks................	80	0.18	12.1	2.6	60	14	2.0	56	10	0.11	0.029	0.58
30 weeks................	80	0.20	11.8	2.6	59	14	--	55	8	0.11	0.026	0.60

U. Calif., Davis, Calif.

Hope, G. W., MacKay, D. C., and Townsend, L. R. THE EFFECT OF HARVEST DATE AND RATE OF NITROGEN FERTILIZATION ON THE MATURITY, YIELD AND CHIPPING QUALITY OF POTATOES. Amer. Potato J. 37: 28-33. 1960.

The highest yields of tubers giving acceptable chip quality were found where potatoes receiving 160 pounds of nitrogen per acre were harvested when at least 80 percent of the leaves had died.

Kennebec consistently outyielded Sebago, matured earlier, and gave satisfactory chip color at all maturities and at all four levels of nitrogen fertilization.

Mature tubers of both varieties gave chips of lighter color than immature potatoes. The effect of maturity on chip color appeared to be due to higher reducing sugar levels in immature tubers.

Potatoes from plots receiving higher rates of nitrogen had greater concentrations of free amino acids and gave darker chips than did potatoes receiving nitrogen at 80 pounds per acre.

Res. Sta., Canada Dept. Agr., Dentville, Novia Scotia, Canada.

Findlen, H. EFFECT OF FERTILIZER ON THE CHIPPING QUALITY OF FRESHLY HARVESTED AND STORED RED RIVER VALLEY POTATOES. Amer. Potato J. 37: 85-89. 1960.

Potato chips were prepared at harvest and after a period of storage and reconditioning. Irish Cobbler and Kennebec potatoes grown with several different levels of nitrogen phosphorus, and potash fertilizers applied at planting time were used.

The fertilizers had no important effect on chip color.

In general, the higher rates of nitrogen application reduced chip yield slightly. This effect was particularly noticeable with the Kennebec variety at harvest time. Chip yields were also slightly lower when potash was present in the fertilizer than when it was absent.

Chips prepared from the Irish Cobbler variety were of slightly poorer color but with slightly higher yield than the Kennebec variety.

AMS, USDA, East Grand Forks, Minn.

Jackson, R. D., and Haddock, J. L. GROWTH AND NUTRIENT UPTAKE OF RUSSET BURBANK POTATOES. Amer. Potato J. 36: 22-28. 1959.

The growth and nutrient uptake of Russet Burbank potatoes at Logan, Utah, were studied. The maximum yield of tops was produced 95 days after planting, at which time they composed 49 percent of the total plant weight. At harvest time the tubers accounted for 78 percent of the total weight of the plant.

The tubers increased about 147 pounds per acre during a 14-day period after a killing frost.

After the 95th day, the total amount of nutrients contained in the tops decreased continuously. The nutrients increased continuously in the tubers. Apparently nutrients were translocated in substantial quantities from the tops to the tubers beginning at the 95th day and continuing throughout the growth period.

The maximum rate of absorption of nitrogen, phosphorus, and potassium occurred in the tubers 88-95 days after planting. During this time the tubers absorbed 1.96 pounds nitrogen, 0.23 pounds phosphorus, and 2.37 pounds of potassium per acre per day.

This crop of potatoes absorbed 139 pounds of nitrogen, 11.6 pounds of phosphorus, and 135 pounds (124th day) of potassium per acre to produce 510 bushels per acre (fresh weight). The tubers accounted for 98 pounds of the nitrogen, 9.7 pounds of phosphorus, and 100 pounds of potassium taken up by this crop of potatoes.

SWCRD, ARS, USDA, Fort Collins, Colo.

Haddock, J. L., and Jackson, R. D. SOME PLANT NUTRIENT RELATIONSHIPS IN THE POTATO CROP GROWN ON A CALCAREOUS SOIL. Amer. Potato J. 36: 56-63. 1959.

A study of the chemical composition of various parts of the Russet Burbank potato grown on a well-drained Millville l soil shows some interesting seasonal relations. A yield of 510 bushels per acre suggests that the crop was fairly well nourished.

The potato crop showed a seasonal decline in Thomas' "quantity factor" for all tissues studied which agreed with his data for leaf analysis. However, the "quantity factor" is considerably below apparently desirable levels for the entire season. This combined with the seasonal behavior of "quality factors" for nitrogen and potassium in tops, roots, and tubers, suggests the possibility of potassium deficiency. This conclusion is not indicated by leaf composition with respect to seasonal potassium "quality factor"

The seasonal "quality factors" for nitrogen, phosphorus, and potassium show consistent disagreement when tops, roots, and tubers are contrasted with leaf tissue from the same plant.

The simple ratios $N:K_2O$: $N:P_2O_5$ and $K_2O:P_2O_5$ for tops, roots, and tubers indicate that nitrogen was in ample supply to this particular crop, and that potassium may have been somewhat limiting. This conclusion is not justified by these ratios in leaf tissue.

SWCRD, ARS, USDA, Logan, Utah.

Laughlin, W. M., and Dearborn, C. H. CORRECTION OF LEAF NECROSIS OF POTATOES WITH FOLIAR AND SOIL APPLICATIONS OF POTASSIUM. Amer. Potato J. 37: 1-12. 1960.

Foliage breakdown was markedly reduced by soil and spray applications of muriate of potash and not influenced by placement of the K fertilizer.

U. S. No. 1 tuber yields in the absence of K sprays were increased by each increment of soil K through 160 pounds K_2O per acre. The weight of tubers below two inches in diameter in the absence of K sprays was reduced with each increment of soil K.

Muriate of potash sprays twice weekly increased the yield and proportion of U. S. No. 1 tubers at all soil K levels. The greatest gain was with the lower K levels. No additional yields on sprayed plots occurred above 160 pounds K_2O per acre. Yield of small tubers was reduced markedly by spraying at the lower K levels.

The highest incidence of brown sunken lesions occurred where no K had been added to the soil and the foliar sprayed. Where some K was available, foliar K sprays significantly reduced this cortical breakdown.

Dry matter content of tubers was not materially reduced by soil K applications up to and including 160 pounds per acre. Where soil potash was applied, foliar potash sprays reduced tuber dry matter content.

Alaska Agr. Expt. Sta., Palmer, Alaska.

Tyler, K. B., Lorenz, O. A., and Fullmer, F. S. SOIL AND PLANT POTASSIUM STUDIES WITH POTATOES IN KERN DISTRICT, CALIFORNIA. Amer. Potato J. 36: 358-366. 1959.

Symptoms of potassium deficiency exhibited by leaf mottling, scorch, and rolling, especially of the younger leaves, were corrected by potash fertilization. Yields were likewise increased by the use of potash. On the more deficient soils it was necessary to add at least 200 pounds of K_2O per acre to eliminate deficiency symptoms of the foliage. It was necessary to apply more than 100 pounds of potash per acre to obtain maximum yields, but yield increases were not obtained by applying more than 200 pounds of potash per acre.

Potassium levels in the petiole tissue as low as 0. 6 percent and as high as 14 percent were obtained. Potassium levels of less than 9 percent during early growth, 7 percent at midseason, and 4 percent at late season were associated with potassium deficiency symptoms in the foliage and reduced yields. On some soils satisfactory levels of potassium in the plant were obtained by applying 100 pounds of K_2O per acre, but in the most deficient soils it was necessary to apply 200 pounds. In all soils, high levels of plant potassium were obtained from K_2O application of 400 pounds or more per acre.

Soil levels of exchangeable potassium of 100 parts per million or less were associated with reduced yields, low plant potassium content, and deficiency symptoms in the plant. Levels of 150 parts per million or more were sufficient for these soils.

There was excellent agreement between the potassium content of the soil, and the response of the crop to potash application as determined both by yield and potassium content of the petiole tissue.

U. Calif., Riverside, Calif.

Houghland, G. V. C. THE INFLUENCE OF PHOSPHORUS ON THE GROWTH AND PHYSIOLOGY OF THE POTATO PLANT. Amer. Potato J. 37: 127-138. 1960.

In any study on the importance of phosphorus in potato production it is essential to recognize the fundamental significance of the phosphate esters in plant growth, particularly their role in the conversion of carbohydrates and in the metabolism of starch.

This study confirms the need for phosphorus in the growth of the potato plant and in tuber development. Moreover, this need has been shown to be highly critical during the early stage of growth when normal meristem development and rapid vine growth are essential for a good crop. Evidence that relatively large amounts of plant phosphorus were needed for subsequent starch phosphorylation is supplied by the finding that tubers from 50-day-old plants contained only 23 percent of the total plant phosphorus, whereas tubers from control plants, 112 days old, contained 83 percent. Viewed from the standpoint of its importance in starch metabolism, the phosphorus contained in potato fertilizers has significance far beyond that heretofore fully recognized.

The results show clearly the fundamental need for phosphorus early in growth of the potato plant, and explains why potato yields are increased when a readily available form of phosphorus is applied to soils well supplied with residual phosphorus.

CRD, ARS, USDA, Beltsville, Md.

Corbett, E. G., and Gausman, H. W. THE INTERACTION OF CHLORIDE WITH SULFATE AND PHOSPHATE IN THE NUTRITION OF POTATO PLANTS (SOLANUM TUBEROSUM). Agron. J. 52: 94-96. 1960.

A highly significant negative correlation existed between Cl in nutrient solution and the uptake of SO_4 in the tops of potato plants. Uptake of SO_4 by roots was significantly increased by additions of P^{32} but not by S^{35} or no radioisotope. Intermediate levels of Cl reduced the uptake of P^{31} as compared with low and high levels of Cl. Chloride also affected maturity and dry weight relations of potato plants.

Jr. Author, Maine Agr. Expt. Sta., Orono, Maine.

Gausman, H. W., Estes, G. O., Corbett, E. G., Carpenter, P. N., and Struchtemeyer, R. A. SOME EFFECTS OF SOURCES OF NITROGEN AND BIURET ON POTATOES. Amer. Potato J. 36: 132-136. 1959.

Some of the effects of biuret on potato plants were studied. Various nitrogen sources were used with and without the inclusion of biuret. The authors make the following conclusions: (1) Sources of N influenced the dry matter production of tops, roots, and tubers of potato plants in greenhouse nutrient culture. The greatest total dry matter yield was obtained with NH_4NO_3, and a combination of 1/2 N from $(NH_4)_2SO_4$ and 1/2 N from $CO(NH_2)_2$ gave the highest tuber yield. (2) Ammonium sulfate alone or in combination with $CO(NH_2)_2$ increased the percentage of N and reduced the percentage of Ca; whereas, $CO(NH_2)_2$ alone or in combination with NH_4NO_3 tended to increase the K content with very little effect on the Ca and N content. (3) The addition of biuret at a rate of 0.03 percent to various N sources decreased dry matter production in all instances. (4) Biuret caused many variations in the percentages of N, P, Ca, and K in potato plants grown with various N sources. The NH_4+ ion appeared to interact more than NO_3- with biuret in affecting the nutrient contents. (5) Biuret inhibited nitrification in nutrient solutions. And (6) typical plant symptoms are described which were obtained on plants grown with biuret in the nutrient solutions.

U. Maine, Orono, Maine.

Barnes G. L. HERBICIDAL AGENTS AS POSSIBLE AIDS FOR ROGUING DISEASED SEED-POTATO PLANTS. Amer. Potato J. 36: 212-218. 1959.

Several herbicidal materials were screened as possible roguing agents on potato plants. Most of the materials were rejected because of their slow killing action and failure to prevent regrowth from seed pieces. In greenhouse and field trials, Diesel oil plus 0.4 percent triethanolamine salt of 2, 4, 5-trichlorophenoxyacetic acid, Diesel oil plus 30 percent of an Isopropyl N- (3-chlorophenyl) carbamate emulsion, and Diesel oil plus 1 percent Dow General Weed Killer were found to be suitable for roguing purposes. In subsequent greenhouse trials, a mixture of Diesel oil and 10 percent MH 30 killed sprayed plants and inhibited sprouting of seed pieces and harvested tubers. This indicates that further work should be done on mixtures of Diesel oil and the newer growth-regulating compounds as chemical roguing agents.

Trials by seed potato growers have indicated that transporting roguers, roguing chemicals, and spray equipment with a tractor to locate and spray diseased plants is a quick, efficient roguing method. At present, however, the seed-pieces and tubers under sprayed plants must be dug and destroyed before harvesting. Further research may bring forth an ideal herbicidal mixture which would kill all of the seed pieces and tubers of sprayed plants and thus eliminate the need for digging them.

CRD, ARS, USDA, Stillwater, Okla.

Fernow, K. H. CHEMICAL ELIMINATION OF VOLUNTEER POTATOES. Amer. Potato J. 36: 407-409. 1959.

Volunteer potato plants, which occur frequently in New York State, constitute a menace to seed production. Their elimination by cultural means is not always practicable. Amitrol was found capable of destroying both plants and new tubers.

If potato plants occur as single scattered volunteers in fields which are fallowed or planted to crops other than potatoes, they can be eliminated by application of amitrol with a hand sprayer. If the unwanted potato plants occur more abundantly and over a wider area, the material might be applied with a weed sprayer or potato sprayer. The most desirable time for spraying seems to be from July 1 to August 20. Since the material destroys plants of many crops by absorption through the leaves, it will be necessary to plan the use of the particular field so as to avoid significant damage to the crop.

Cornell U., Ithaca, N. Y.

Timm, H., Bishop, J. C., and Hoyle, B. J. INVESTIGATIONS WITH MALEIC HYDRAZIDE ON POTATOES. 1. EFFECT OF TIME OF APPLICATION AND CONCENTRATION UPON POTATO PERFORMANCE. Amer. Potato J. 36: 115-123. 1959.

Maleic hydrazide (MH-40) was applied to the foliage of five varieties of potatoes grown at two California locations, Shafter and Tulelake. Plants were sprayed two and three weeks before harvest, and harvested tubers were held for six months at 45°-55° and 68° F.

No significant differences in yield or specific gravity of tubers due to MH-40 spray treatments were found.

Increasing concentrations of MH-40 spray resulted in a reduction in sprout development and loss of tuber weight in stored potatoes. Application three weeks before harvest was more effective in reducing losses in storage than application two weeks before harvest.

A greater loss in tuber weight and more sprouting occurred at 68° F. than at 45°-55° F.

Applications of MH-40 caused no change in chipping or cooking quality of tubers.

U. Calif., Davis, Calif.

Erickson, H. T. POTATO SCAB CONTROL ON ORGANIC SOILS. I. INITIAL RESPONSE TO PCNB. Amer. Potato J. 37: 18-22. 1960.

Incidence of potato scab was significantly reduced on a muck soil of high exchange capacity by PCNB (Pentachloronitrobenzene) with no reduction in tuber yield at rates up to 300 pounds per acre. Rates of 100, 200, and 300 pounds of actual fungicide were used. Broadcast application followed by thorough mixing with the soil to a 6 to 8-inch depth proved satisfactory. Row application was not used in these tests.

At the higher rates residual activity was apparent the year following application. Repeated treatments the second year caused further significant scab decline. Accumulative reduction in scab incidence from a series of moderate yearly doses appears to be the most efficient use of PCNB on muck soil. This practice would be inconsistent with standard cropping methods used on muck, however, since potatoes are not ordinarily raised on the same muck soil in successive seasons. Economic considerations will be important in determining the extent of PCNB use and its acceptability among potato growers.

Purdue U., Lafayette, Ind.

Folsom, D. POTATO TUBER BRUISE ROTS IN RELATION TO CROP ROTATION IN MAINE 1945-1956. Amer. Potato J. 36: 154-161. 1959.

Ninety Maine fields which were growing potatoes in 1945 were observed for the following 11 years regarding the kind of crop present. The average crop rotation was 2 years of potatoes in every 5 years, with the other 3 years mostly in grass and legume crops. At the end of the growing season of 1955, soil samples were taken from 20 fields in which the most recent potato year varied from 1945 to 1955. Katahdin tubers were washed, coated (or not) with soil, bruised, stored at 38° F., and examined for bruise rot. The bruise rot, caused by Pseudomonas fluorescens, was decreased by soil inoculation, and became more abundant with the increase in number of years since potatoes. The test was repeated in the following spring, when again soil inoculation decreased bruise rot, which in this instance, was caused chiefly by Ps. fluorescens and to some extent, by Phoma tuberosa. The idea that these two organisms were present on the skin of the washed tubers and entered the tubers along bruise cracks, was confirmed by a further similar test in which bruise rot was reduced by disinfection before bruising.

At the end of the growing season of 1956, soil samples were taken from one series of 26 fields with the last potato year ranging from 1945 to 1956, and from another series of 17 fields with the last 7 years or less consisting of potato years. The 1955 test was repeated. Practically all the bruise rot was soon static and was caused by Ps. fluorescens and P. tuberosa. It was decreased by soil inoculation and its abundance was not correlated significantly with crop history. In a duplicate test with the storage temperature at 50° F. instead of 38° F., similar results were obtained except that some bruise rot was caused by Fusarium sambucinum f. 6.

Internal tuber inoculations with agar cultures produced active rot with Fusarium avenaceum at 50° F., with F. coeruleum at 35 to 50° F., with F. sambucinum f. 6 at 35 to 50° F., with Phoma tuberosa at 35 to 50° F., and with Pseudomonas fluorescens at 35° F. but not at 50° F. Internal tuber inoculations with the soil samples of 1956, followed by storage at 50° F., produced practically no rot, but when followed by storage first at 35° and then at 50° F. produced some rot which yielded cultures of F. avenaceum and P. tuberosa. No Phoma rot was produced by soil samples from fields free from potatoes since 1951 or before, and the highest percentage of inoculations producing Phoma rot was with the soil samples producing potatoes in 1956.

Maine Agr. Expt. Sta., Orono, Maine.

Burrage, R. H. INSECTICIDE ROW TREATMENTS FOR THE CONTROL OF WIREWORMS IN POTATOES. Canad. J. Plant Sci. 40: 178-182. 1960.

In field plots, where about 20 percent of the potato tubers were damaged by wireworms in untreated plots, not more than 5 percent were damaged after band treatments with aldrin or heptachlor dusts, granules, or impregnated fertilizers, applied at 1 or 3 lb. of toxicant per acre during planting. At least 15 percent of the tubers were damaged after band treatment with chlordane dust at the same rates. Damage after treatments with aldrin or heptachlor dusts applied in the open furrow by hand immediately before planting was similar to that after band treatments at the same rates. Where about 40 percent of the tubers were damaged in untreated plots, 9 and 15 percent of the tubers were damaged after band treatments with granular aldrin and heptachlor respectively, each at 3 lb. per acre; 23 and 28 percent of the tubers were damaged after band treatments with the same insecticides at 1 lb. per acre. Thus, the treatments reduced damage enough to bring the potato crop to top table stock grade, without culling, only where potential damage was light. None of the treatments reduced wireworm numbers more than 75 percent. None of the treatments increased the yield of tubers. Furrow treatments with aldrin and heptachlor dusts reduced yield in one of two tests, presumably because of phytotoxicity.

Res. Sta., Canada Dept. Agr., Sakatoon, Saskatchewan, Canada.

ECONOMIC AND SOCIAL

Costs and Returns

Anderson, R. F. SUPPLY, PRICE, AND UTILIZATION OF COTTON IN GEORGIA WITH UNITED STATES AND REGIONAL COMPARISONS. Ga. Agr. Expt. Sta. Mimeo. Ser. N.S. 96, 72 pp. 1960.

Cotton acreage in Georgia reached its peak in 1914 when 5,157,000 acres were planted. Since that date, the acreage has declined fairly steadily to 381,000 harvested acres in 1958. Conditions contributing to the decrease in cotton acreage in Georgia include: (1) Acreage allotment programs; (2) boll weevil damages which made cotton production less profitable; (3) development of alternative or supplementary agricultural enterprises; and (4) competition for cotton markets by low-cost producing regions of the United States.

The largest acreage of cotton harvested in the United States since 1909 was 44,608,000 acres in 1926. The U.S. acreage had declined to 11,858,000 in 1958, an extremely low acreage resulting from the Soil Bank Program. During the period 1920-1930, the United States harvested cotton acreage represented 50 percent of the world's total; in 1954-1958, U.S. acreage accounted for only 20 percent of the world cotton acreage. A partial explanation of this change is found in the government price support programs for cotton which began in the early 1930's. One effect of these programs has been to reduce the acreage of cotton planted in the United States. While these programs were operating in the U.S., a number of foreign countries were striving to increase their cotton acreage; consequently, foreign acreage increased relative to that in the U.S.

Cotton acreage has declined in three of the four major producing regions in the U.S. since 1909. The Southeast, Delta, and Southwestern areas show decreases while acreage in the Western region increased.

In the United States, the average yield of cotton lint per acre rose from 183 pounds in 1909-18 to 345 pounds in 1949-58, an increase of 88 percent. For these same periods in Georgia, cotton yields per acre rose from 209 pounds to 301 pounds, an increase of 44 percent.

The farm value of the U.S. cotton crop is second only to the value of the corn crop in most years. The farm value of wheat has exceeded that of cotton in some years. During the period 1909 to 1958, the value of the U.S. cotton crops (excluding cottonseed) has ranged from a low of $423,975,000 in 1932 to a high of $2,868,720,000 in 1951.

In Georgia, cotton was the source of 62.0 percent of cash receipts from farming in 1924; by 1957, cotton accounted for only 11.1 percent of total cash receipts.

Ga. Agr. Expt. Sta., U. Ga., Col. Agr., Experiment, Ga.

Rogers, R. H., and Bonnen, C. A. ECONOMICS OF MECHANICAL COTTON STRIPPING ON BLACKLAND FARMS. Tex. Agr. Expt. Sta. B. 949, 11 pp. 1960.

Harvesting cotton with mechanical strippers is more economical on the Blackland Prairies than hiring labor crews to pull or snap by hand. An economical evaluation of machine versus hand harvesting covering both "good" and "bad" years, and years with and without acreage controls, indicates that stripping increases the returns from cotton production.

Income may increase $10 to $25 a bale when cotton is stripped instead of being hand-harvested. An average increase of $14 per bale was recorded in a study of harvesting methods during 1952-55. Growers who used improved production methods throughout the season obtained the best results. Proper seedbed preparation, adequate insect control, timely cultural practices, and efficient desiccation or defoliation and stripping operations are necessary to obtain good yields and better than average grades for maximum returns. Gins are equipped to turn out acceptable grades if properly harvested seed cotton is delivered.

Good stripper operators usually have no more field loss than do farmers who hire crews to hand harvest their crop. However, on cooperating farms, about 200 pounds more seed cotton were required to produce a 500-pound bale of machine-stripped cotton than a bale of hand-pulled cotton. The average discount for stripped cotton versus hand-pulled cotton was 100 points, or $5 a bale.

Farmers with average yields of only a quarter-bale an acre cannot expect a satisfactory return from cotton at current prices, regardless of the harvesting methods used.

Growers with 50 or more acres of cotton and with yields of a half-bale or more per acre can harvest cotton more economically with their own strippers than by hiring stripping done at $1 per hundredweight of seed cotton hauled to the gin.

FERD, ARS, USDA and Texas Agr. Expt. Sta., College Station, Tex.

Stallings, J. L. ONION MARKETING METHODS, FACILITIES, AND COSTS IN NEW MEXICO. N. Mex. Agr. Expt. Sta. Res. Rpt. 38, 15 pp. 1960.

New Mexico farmers have various alternatives for marketing their onions. The alternatives may vary from contracting for a "package deal," including every operation from the lifting through selling, to the farmer doing most of the operations himself.

Typical custom rates and costs during 1959 for a 50-pound processed bag of onions were: 25 cents for topping and hauling, 20 cents for grading, 21 cents for the sale bag, 10 cents for the broker's fee and one to two cents for government inspection and miscellaneous costs.

No custom rates were given for undercutting as it is usually done by the farmer. Undercutting costs averaged about one-half cent per bag.

Typical package deals, including everything from topping through selling, but excluding undercutting, were 85 cents for a 50-pound processed bag.

Volume is the most important factor a farmer must consider when deciding whether he should own his grading equipment. Fixed costs per bag for grading decline rapidly as volume is increased up to about 5,000 bags per year and to a lesser extent at larger volumes. Other costs are fixed on a per bag basis as volume increases. The findings in this report indicate that, in general, custom hiring of the grading operation is more profitable for the farmer with small acreage or volume. However, as acreage and volume become larger, it becomes more feasible for the farmer to own his equipment.

Agr. Expt. Sta., N. Mex. State U. Agr., Engin., and Sci., University Park, N. Mex.

Green, W. J., Irish, A. E., and Mumford, D. C. COST OF PRODUCING APPLES AND PEARS IN THE HOOD RIVER VALLEY. Oreg. Agr. Expt. Sta., Sta. B. 573, 53 pp. 1960.

This bulletin discusses production of apples and pears in Oregon, with particular reference to the Hood River Valley. The cost-of-production data presented are based on research findings resulting from a detailed study of fruit growers' costs in the Hood River Valley extending over a ten-year period.

Agr. Expt. Sta., Oreg. State Col., Corvallis, Oreg.

Boykin, C. C. Jr. COSTS OF ROOTPLOWING AND SEEDING RANGELAND, RIO GRANDE PLAIN. Tex. Agr. Expt. Sta. MP-425, 8 pp. 1960.

Invasion of woody plant species on the Rio Grande Plain of Texas has so decreased forage production that many ranchmen have bought additional rangeland or have invested in range improvement to maintain or increase family income.

Rootplowing and seeding in the same operation with the introduced species blue panic and buffel grasses have, in many instances, produced phenomenal results in brush kill, especially mesquite, and in successful grass stands.

On the basis of personal interviews with 29 ranchmen in McMullen, LaSalle, Frio, and Medina counties, and additional information from the SCS and ASC offices and other sources, a determination of treatment cost was made.

Ranches in the study ranged from 163 to more than 18,000 acres, and averaged 2,010 acres. Total area rootplowed and seeded per ranch ranged from 10 to almost 1,200 acres, with an average of 241 acres. Up to 40 percent of the total acreage was treated on the smaller ranches; 3 to 5 percent of the total acreage was treated on the larger ranches.

A common sequence of operation was first to chain the brush, then rootplow and seed, and defer grazing on the treatment area. In most instances, these operations were contracted by local equipment operators. Chaining for the most part had been done in previous years. The most frequent contract prices quoted were $3 per acre for chaining, and $10 per acre for rootplowing and seeding. One dollar per acre was the assigned cost for non-use of the land for 1 year. In cases of failures to obtain adequate grass stands retreatment by use of a rootrake and attached grass seeder is becoming widespread. A common contract price for this operation was $6 per acre plus an assigned cost of $1 per acre for an additional years deferment.

Of 490 contract operations observed during 1953-58 by range technicians of the Soil Conservation Service on the six major range sites in the area, 166 grass stands resulted. This made an average failure of 66.1 percent. Using the 66.1 percent failure as a risk factor, the determination was made that treatment, including chaining, rootplowing and seeding, and range deferment, resulted in a cost of $18.63 per acre. This figure does not include additional costs of fencing water facilities, grubbing, and weed control, which may or may not be necessary. Cost-sharing assistance was obtained by many of the ranchmen interviewed.

Benefits received from this method of range improvement vary and many cannot be measured at this time. Increases in livestock carrying capacity and in calf weights, fewer insects and reduced handling costs were reported.

Numerous management problems confront the ranchman because of the nature of the introduced grass species and the often limited acreages on which they occur. Indications are that the areas rootplowed and seeded successfully can be handled best as temporary pastures in a manner similar to sudangrass.

Texas Agr. Expt. Sta., College Station, Tex.

Larson, G. H., Fairbanks, G. E., and Fenton, F. C. WHAT IT COSTS TO USE FARM MACHINERY. Kans. Agr. Expt. Sta. B. 417, 48 pp. 1960.

The total cost of operating farm machines is made up of the cost of machinery, power, and labor.

Machinery costs are grouped under two headings: Costs of ownership and costs of operation. Costs of ownership include charges for depreciation, interest on investment, taxes, insurance, and housing. Costs of operation include charges for fuel, oil, lubrication, repairs, and labor.

Depreciation costs must be determined in calculating the cost of using farm machinery. They are needed to determine resale values, trade-in values or appraisal values of used machines. Three methods of estimating depreciation are given. The straight-line method is the simplest to use and is considered satisfactory when the machine is to be used its entire life and not traded in. The declining-balance and sum-of-the digits methods are useful in estimating resale or appraisal values, as well as for income tax purposes.

Interest on the investment is the second largest cost-of-ownership item and is included because money used to purchase farm machines cannot be used for other productive investments.

Repair costs depend on the nature and amount of use. Repair costs, for convenience, are expressed as a percentage of the initial cost in calculating machinery costs. Because they need to have their cutting edges sharpened, plows and other tillage machines have among the highest of all farm machinery repair costs.

Taxes, including sales tax, amount to about 1.0 percent per year of the initial cost of a machine.

Annual insurance costs amount to about 0.25 percent a year of the original cost of the machine.

A large percentage of Kansas farm machinery is not sheltered from the weather. An annual charge of 1.0 percent a year of the initial cost is recommended for housing when machinery is sheltered.

The labor cost of the operator is usually the largest cost item of operating a farm machine. At $1.25 per hour, the cost of labor represents 47.5 percent of the cost of plowing with a 4-plow-size tractor and a mounted, 4-bottom, 16-inch plow. The high cost of labor has influenced strongly the trend to more power and bigger machine units.

Machinery costs can be reduced by increasing annual use up to the point beyond which untimeliness of operation causes reduced returns, increasing useful life by proper operation and care of machine, and by reducing the amount invested in equipment when advantageous.

An increase in custom work is a logical development with higher priced machines of greater capacity. It is estimated that 25 to 30 percent of the 1959 Kansas wheat crop was harvested by custom-operated combines.

A procedure has been presented for making total machinery cost estimates with alignment charts. A method to determine the appropriate time to replace a given machine is presented. A method to determine the break-even point--that is, when to hire a custom operator or when to own equipment--is presented.

Agr. Expt. Sta., Kansas State U., Manhattan, Kans.

Institutional and Educational

LeRay, N. L., and Rohrer, W. C. EMPLOYMENT OF NEGRO MANPOWER IN CALVERT COUNTY, MD. Md. Agr. Expt. Sta. B. 467, 37 pp. 1960.

In March 1957, about 20 percent of the labor force residing in open-country Negro households in Calvert County, Md., were available for work. Half of these were actively seeking work.

Of 136 open-country Negro households surveyed, slightly more than half were on farms by the census definition. Of the farm households, 31 percent were on part-time, 4 percent on residential, and the rest on commercial farms.

Tobacco was the main crop sold. Most families had home gardens and raised some livestock for home consumption.

Households with low incomes were concentrated on the farms. Only 36 percent of the nonfarm households had incomes of less than $2,000, compared with 64 percent of the farm households. Largely because of their nonfarm employment, part-time farmers had higher earnings than commercial farmers.

More than three-fourths of the members of the sample households had done some work in the year preceding the survey, but only 43 percent had worked 100 days or more. Individuals who listed their chief activity as farm operation averaged 169 days of work, compared with 156 and 209 days for those who were primarily farm wage workers and nonfarm workers, respectively.

Any development program for Negroes in Calvert County would need to consider the improvement of opportunities for nonfarm employment. Of the persons available for work in March 1957, all except 11 percent preferred nonfarm jobs, despite the fact that more than half the sample households were on farms.

The most economically feasible agricultural adjustment program is one that will promote part-time farming. Part-time farming could serve as a transition stage from full-time farming to full-time nonfarm work, as a permanent way of life, or as a transition stage from farming a small unit to operating a larger full-time farm.

FERD, ARS, USDA and U. Md., College Park, Md.

Connor, L. J., Lagrone, W. F., and Back, W. B. FARM AND NONFARM INCOME OF FARM FAMILIES IN WESTERN OKLAHOMA, 1956. Okla. Agr. Expt. Sta. B. B-552, 19 pp. 1960.

The amounts and characteristics of off-farm work and nonfarm income of farm operators and their families in the commercial farming areas of western Oklahoma was determined. The study was based on an analysis of data of a survey of 404 farm families in eight western Oklahoma counties.

About 90 percent of the farm families in the survey reported some off-farm income. The average cash income per family was $3,783. The components of this income were as follows: net farm income, $2,105; gross off-farm work income, $978; and other off-farm sources of income $700. Off-farm income thus comprised about 44 percent of the cash income of these farm families.

Off-farm work by the farm operator was the leading source of off-farm income. Forty percent of the farm operators in the survey had income from off-farm work. Approximately 23 percent of the operators worked off their farms over 100 days per year. Off-farm work was more prevalent among the younger farm operators and those with low equities in assets managed, low net worths, or small farms. Off-farm work by farmers in western Oklahoma is not new. It appears to be increasing with time as a means of increasing farm family incomes.

Other off-farm sources of income contributed to the family income of many farm families, particularly those of the older operators. About three-fourths of the farm families reported other off-farm sources of income, with royalties and mineral leases as the major source.

Farm operators who received more than 50 percent of their cash income from off-farm sources controlled about 30 percent of the total land resources in the survey. Farmers who received little or no off-farm income controlled slightly more than one-third of the total farmland and cropland.

It is suggested that the equity in assets operated and net worth of the individual farm operator greatly influences the type of adjustment he may pursue. Farm operators with limited resources may best increase their income through off-farm employment. Those with more adequate resources may increase the size of their farm operations and thereby enchance their income.

FERD, ARS, USDA and Agr. Expt. Sta., Okla. State U., Stillwater, Okla.

Durost, D. D., and Barton, G. T. CHANGING SOURCES OF FARM OUTPUT. U.S.D.A. Prod. Res. Rpt. 36, 57 pp. 1960.

Except for interruptions during the drought and depression period of the 1930's, the trend for the volume of farm output for human use has been consistently upward in the United States since 1870.

Between the end of the Civil War and the beginning of World War I, expansion of the physical cropland base was the major factor in the growth of output. The total acreage of cropland, farm output, and farm-produced power of horses and mules were each about three times as large in 1920 as in 1870.

Between World War I and World War II, farm output increased by 22 percent and at an annual rate of 0.77 index points (1947-49 = 100). Half the increase was accounted for by the shift from horses and mules as a source of power to mechanical power, which released large amounts of crop and pasture land, labor, and other resources to produce products for human use rather than feed for work animals. Second in importance was crop production per acre. A greater volume of product added by livestock ranked third as a source of expanded output.

From 1940 to 1955, farm output increased at an annual rate of 1.9 index points. Crop production per acre was responsible for more than 40 percent of the increase. Fertilizer accounted for nearly half the increase in crop outturn per acre; other contributing factors were increased irrigation and use of hybrid corn and other improved varieties of crops. Weather was better at the end than at the beginning of the 15-year period, but less than 10 percent of the increase in total farm output is attributed to this change. The upturn in volume of product added by livestock ranked second as a source of greater output. The shift from animal to mechanical power continued, but in this period ranked third as a source of greater output.

ARS, USDA, Inform. Div., Washington 25, D.C.

Ottoson, H. W. TO OWN OR RENT? Western Crops and Farm Mangt. 9(1): 18-20, 22. 1960.

Renting and owning land represent two alternative arrangements by which a man can gain control of land in order to use it. People sometimes are inclined to view tenancy as an arrangement which is socially inferior to ownership. However, this is not necessarily the case. Each is adapted to certain kinds of resource situations; there is no more reason why a desirable farm business cannot be based on leased land than on land owned by the operator. In fact, it may be more economical and profitable to lease and operate a large farm than to own and operate a small under-capitalized farm.

Three basic leasing arrangements are used--the cash lease, crop share, and livestock share. Of these, the crop share is the most popular, including the so-called crop share cash, followed by the livestock share.

CASH LEASE.--The advantages of the Cash Lease are: (1) Fixed rental payment allows tenant to "cash in" on superior management decisions and particularly profitable resource inputs; (2) tenant has greater freedom in decision making; and (3) there is no problem of measuring amount of rental share. Disadvantages are: (1) All risk of crop failure or price decline is carried by the tenant; (2) it may be hard to keep some landlords interested in the farm as long as they receive rent; and (3) it requires the most capital of any type of lease.

CROP SHARE LEASE (AND CROP SHARE CASH).--The advantages of the Crop Share Lease (and Crop Share Cash) are: (1) Landlord shares many of the operations inputs such as seed and fertilizers; (2) landlord shares some of the price and yield risks; and (3) rental varies directly with conductivity of the soil for a specific share. Disadvantages are: (1) Results of superior decision making are shared with the landlord; and (2) the landlord will expect more voice in running the business.

LIVESTOCK SHARE.--The advantages of the Livestock Share are: (1) Require less capital than cash or crop share leases; (2) landlord may be more interested in improvements and maintenance than under other leases; (3) an experienced landlord may be interested in providing considerable managerial assistance; and (4) the landlord shares all of the risks of farming. Disadvantages are: (1) If the landlord is not an experienced farmer, the tenant may be sharing an undue part of his own management ability with the landlord; (2) landlords tend to be interested in enterprises which commit the tenant to heavy labor use; and (3) the process of joint decision making may be burdensome and time consuming.

Most farmers have the goal of land ownership at some time in their career. Buying a farm is a very complicated matter, and the kind of decision it represents can have crucial effects on the success of the farm business for many years to come.

OWNERSHIP.--The advantages of ownership are: (1) Security of tenure. One can plan the farm operations in terms of the long-run. (2) Satisfaction of ownership. People take pride in owning land. (3) Managerial freedom. An owner-operator has great freedom of decision making and of taking the consequences for these decisions. And (4) the incentive to "keep the place up" and to make improvements; the owner-operator may be challenged to spend time and money in enterprises and improvements in which a tenant-operator might not be interested--landscaping, shrubbery, etc. The disadvantages of ownership are: (1) With limited funds an owner operator may have too small a farm to exploit economies of scale, particularly with respect to machinery use; (2) there are limits beyond which volume of business can be expanded on a small farm; (3) a farmer may not be able to use his managerial ability to capacity on a small farm; (4) it is more risky to buy a farm under a mortgage than to rent it under a crop share or livestock share lease; (5) a man who has his money "tied up" in land may be limited on capital for the other resource items necessary to operate the business; and (6) buying a farm commits a person in a long-run sense to a particular tract of land.

An increasing trend in farming which has taken place during the last 10 years is part ownership. A part owner is a farmer who operates both rented land and land which he owns, all as one managerial unit.

The notion of part ownership illustrates the flexibility which characterizes modern farming. Ownership and tenancy are not clear-cut alternatives. They should rather be regarded as tenure tools which an operator can use to fit his own individual situation.

U. Nebr., Lincoln, Nebr.

Lagrone, W. F., and Connor, L. J. FARM ADJUSTMENT OPPORTUNITIES ON FINE-TEXTURED SOILS OF SOUTHWESTERN OKLAHOMA. Okla. Agr. Expt. Sta. B. B-538, 48 pp. 1960.

Farm economy in southwestern Oklahoma is tied closely to two cash crops, wheat and cotton. In recent years, acreage allotments have reduced the acreages planted to these crops. Income opportunities have been further reduced by lower prices for wheat and cotton and rising costs.

A typical farm in the area has a wheat allotment of 180 acres and a cotton allotment of 45 acres. It contains 480 acres of land, with 360 acres of cropland and 110 acres of native pastureland. The cattle enterprise consists of 13 beef cows, 2 milk cows, 2 yearling heifers, and 1 beef-type bull.

To provide information to help farmers make more profitable use of their resources, five alternative farming systems for a typical farm were evaluated, three systems using crop acreage allotments and two assuming no allotments. With allotments in effect, highest net returns would result from the system using most of the cropland not in wheat and cotton allotments for production of oats. With no allotments, a system with large wheat and cotton acreages would be slightly more profitable than one emphasizing beef cattle.

All plans considered would yield low returns for management and family labor. None would utilize all family labor or tractor power. Under most systems, addition of 160 acres to the farm would more fully utilize these resources and would increase profits.

Evaluations were based on detailed information on crops and livestock practices, yields, and other phases of farm operations obtained in interviews with 50 southwestern Oklahoma farmers, whose farms were of the usual size and type for the area.

FERD, ARS, USDA and Okla. State U. Expt. Sta., Stillwater, Okla.

Fenton, E. E. CHANGES IN LAND USE IN MICHIGAN SOIL CONSERVATION DISTRICTS. J. Soil and Water Conserv. 15: 20-23. 1960.

The changes in land use that would be effected by conservation farm planning were studied. No attempt was made to determine the shift in acreages of individual crops that would be brought about and consequently no effort was made to evaluate the effects of such planning on the total production of any agricultural commodity. Fairly consistent trends are noted in the land use changes that a general adoption of conservation plans would bring about. Over most of the area of the state there would be large reductions in the use of land for unproductive permanent pastures and miscellaneous and idle purposes. In many areas, substantial acreages of land being used for such purposes would be reforested. Acreages of row crops and small grains generally would be reduced and the acreage of rotation hay and pasture generally would be increased.

Additional new effective techniques for soil management and erosion control have been developed since many of the conservation farm plans included in the study were prepared. Soil management practices such as minimum tillage and a better use of crop residues have contributed to the modification of conservation planning standards. Such practices frequently permit a more intensive cultivation of the land than was possible under planning standards that were used in the preparation of many of the plans under study.

The study indicates that conservation farm planning, using planning standards that were then currently acceptable, would result in an 18.04 percent reduction in the acreage of row crops. This was necessary because, in overcoming problems of soil erosion and loss of organic matter, more frequent use of the land for soil building crops was needed. Today, minimum tillage and greater use of crop residues are practices which serve to lessen the indicated reduction in the use of land for row crops, and at the same time lessen the extent of the increase in rotation hay and pasture.

Watershed Planning Party Leader, SCS, USDA, East Lansing, Mich.

Boddy, H. AGENCIES TEAM UP TO HELP RANCHERS GET GOOD GRASS. Soil Conserv. 25: 103-104. 1960.

Good grass growth and drainage helped C. O. Bankhead and son whip a tough alkali condition on their wet lands near Bethany in San Joaquin County, Calif. This shows what farmers can gain by giving today's tested soil and water conservation tools a trial.

The Bankheads' success in getting grass to grow on alkaline, salty acres called for giving their land the full conservation treatment, including drainage, land leveling, relocation of irrigation borders, and reseeding to improved grasses and legumes plus proper grazing use.

All this work was carried out with help from Soil Conservation Service technicians, Agricultural Research Service specialists, and the Agricultural Conservation Program through the Eastern Alameda County Soil Conservation District. The work paid off well. Grass was more than doubled on the worst alkali areas. On other treated acres growth was high and lush the first year.

The 450 acre ranch was located where the land lay behind dikes along the San Joaquin River and there was no outlet for drainage water. The situation resulted in a high water table and concentration of salts and alkali on portions of the ranch lands.

There was a lot of alkali on 200 acres and the rest of the land was fairly salty. Irrigation runoff and subsurface drainage from higher areas gave the farm a high water table.

15,000 feet of new drainage ditches were installed and 8,000 feet of old ditches were improved. These main disposal ditches were installed over a 3-year period with dragline equipment at a cost of $6,000.

The job of these disposal ditches is to carry water to a sump where it can be pumped over the dike to the San Joaquin River.

On some of the worst alkali land drained, grass is coming back with no other treatment.

Borings were made on some of the worst alkali spots in mid-March and no free water was found at 5-foot depths.

SCS, USDA, Berkeley, Calif.

Luker, C. GREAT PLAINS CONSERVATION PROGRAM: A SECOND ANNIVERSARY REPORT. Soil Conserv. 25: 123-126. 1960.

The approach of the Great Plains Conservation Program to the agricultural problems of the vast area was direct and clear cut. Its objectives: To halt or reduce erosion, build drought resistance as much as possible into the operations of farmers and ranchers, and to make agriculture in the Great Plains as dependable a business as soil, climate, and agricultural science will permit.

The program's principal offering is a complete soil and water conservation plan for a farm or ranch, based on careful studies of soil and range conditions and custom cut to fit the needs of the unit and the operator thereof.

The program's built-in booster comes from cost-sharing in Federal Funds, attached to a timetable for getting the basic job speeded up and done in no less than 3 years nor more than 10 on any farm or ranch.

Congress put a limit of $25 million in Federal spending on the program for any single year, with a $150 million ceiling for the whole program.

An immediate target of all soil conservation work in the Great Plains is the estimated 12 to 14 million acres of low-grade cropland which is too vulnerable to wind and water, and too low in yields over a long period, to be continued in cultivation. This land, to be useful and permanently productive, must be in permanent cover. That means grass usually.

Water for all uses, including the moisture that can be stored in the soil, is another pressing concern; for, in the Plains, drought can always be just around a flip of the calendar. Conservation practices are designed to make the most effective use of the water that is available. Some of these practices require investment by the landowner in dams, wells, water-spreading systems, irrigation improvements, or spring development.

At the end of the first 2 years, about 3,300 farmers and ranchers had entered the program. They had taken advantage of the opportunity to apply all the needed soil and water conservation to their land in return for the technical assistance offered by the trained men of the Soil Conservation Service and for the cost-sharing in Federal funds. Federal cost-sharing is based on the average cost of installing a given practice in a county. It ranges from 50 percent in the case of some of the less urgent practices to 80 percent in high priority revegetation work.

The 3,300 farmers and ranchers represent about 1 percent of the 335,000 landowners and operators in the designated area of the Great Plains. Projecting the present average cost per unit for establishing enduring conservation measures (about $5,300) indicates that the spending of the entire $150 million authorized for the program will mean complete treatment for about 10 percent of all Great Plains units.

SCS, USDA, Washington 25, D.C.

Cohee, M. H. ECONOMIC EVALUATION OF SOIL AND WATER MANAGEMENT MEASURES. Agr. Engin. 40: 740-745. 1959.

The author brings together in one "package" the essentials of economic evaluation of soil conservation.

Agr. Econ., Engin. and Watershed Planning Unit, SCS, USDA, Milwaukee, Wisc.

Christ, J. H. CONSERVATION PROBLEMS--IN THE STATE OF HAWAII. Soil Conserv. 25: 76-79. 1959.

This article presents some of the soil conservation problems in Hawaii, and tell how they are being solved.

Difference in soil, climate, and crops make the problem of soil conservation in Hawaii a lot different from problems in the United States.

SCS, USDA, Honolulu, Hawaii.

Christ, J. H. OLOHA HAWAII--SOME WATER AND SOIL CONSERVATION ASPECTS IN THE ISLAND PARADISE. J. Soil and Water Conserv. 15: 11-19. 1960.

Organization of Soil Conservation Districts in Hawaii is virtually completed. Sixteen districts have been organized since enactment of authorizing legislation in 1947. SCD's include 3,474,632 acres comprising 4,410 farms.

Conservation problems here cover a wide range of conditions, many of them within narrow ranges of climatic and elevational limits. The public is giving good support to the program aimed at protecting and improving Hawaii's land and water resources.

This article stresses the various water and soil conservation problems in Hawaii.

Preliminary information from Hawaii's conservation needs inventory provides expressive data on land conditions in this new state. The land area shown in the following table is exclusive of federal lands, military reservations, national parks, other lands, and urban lands. "Other lands" is defined as farmsteads and idle land, wildlife areas, and other areas not classified in the categories listed.

DISTRIBUTION OF LAND BY CAPABILITY CLASSES, HAWAII

Class	Acres	Total land percent	Percent farmed	Percent pasture	Percent watershed	Percent other
I	20,940	0.6	84.0	6.4	9.0	
II	120,880	3.4	84.0	11.4	3.2	1.4
III	221,100	6.2	35.6	24.5	36.2	3.7
IV	279,300	7.8	29.0	27.5	40.7	2.8
I-IV	642,220	18.0	43.4	22.8	31.1	2.7
V	820	0.02	0	100	0	0
VI	726,270	20.3	4.7	31.3	56.0	8.0
VII	1,723,920	48.3	0.07	15.5	77.0	7.43
V-VII	2,451,010	68.7	1.4	20.2	70.8	7.6
VIII	473,380	13.3	0	0.9	9.4	89.7
All land	3,566,610	100	8.8	18.1	55.5	17.6

The urgency for carrying out effective conservation measures is strikingly shown when only 18 percent of the land available is in classes I to IV.

State Conservationist, SCS, USDA, Honolulu, Hawaii.

Johnson, H. A. ALASKA, AGRICULTURE AND ADVENTURE. J. Soil and Water Conserv. 14: 205-211. 1959.

A report on Alaska with its soil, agriculture, and economical problems.

FERD, ARS, USDA, Washington, D. C.

BIOLOGY

Fish

Lewis, W. M., and Gunning, G. E. NOTES ON THE LIFE HISTORY OF THE STEELCOLOR SHINER, (NOTROPIS WHIPPLEI (GIRARD). Ill. State Acad. Sci. Trans. 52 (1&2): 59-64. 1959.

The steelcolor shiner is studied to learn of its possible value as a commercial bait species. This species was considered because of: (1) The occurrence of dense populations in pond-like environments; (2) the shiner's tolerance to being handled in warm weather; and (3) its pronounced activity in aquaria.

The authors summarized their work as follows: (1) The steelcolor shiner has a life span of no more than two years; (2) the maximum size attained by individuals from Crab Orchard Lake approximates two inches; (3) one-year-old fish spawn in late August or early September, whereas two-year-olds spawn in July; (4) steelcolor shiner females contained an average of 1, 049 eggs; (5) spawning facilities for culturing the species should include spawning boards; and (6) the steelcolor shiner is primarily insectivorous.

Southern Ill. U., Carbondale, Ill.

Anderson, R. D., Sedgley, E., and Ruehle, C. ONE WAY TO IMPROVE STREAM FISHING. Soil Conserv. 25: 33-35. 1959.

A clear, fast, mountain stream was improved along its course on a 628 acre ranch by the following methods: (1) To slow down the stream, it was made to meander as much as possible. A bulldozer and dragline was used to build low rock and gravel dams. These were located at spots which forced the stream back into former ox-bows. (2) To deepen part of the stream, rocks and boulders were removed from the stream bed to form loose rock dams. (3) Large boulders were rolled into the stream to make cover and still-water spots. (4) Logs were anchored in some spots for shade and still water. (5) Where needed, riprapping was used to protect the banks. (6) Bridges were added so that both sides of the creek could be fished.

The stream portion on the Marvine ranch has approximately three times as much water as unimproved sections. Trout fishing has greatly improved without restocking.

SCS, USDA, Denver, Colo.

Mayhew, J. THE USE OF TOXAPHENE AS A FISH POISON IN STRIP MINE PONDS WITH VARYING PHYSICAL AND CHEMICAL CHARACTERISTICS. Iowa Acad. Sci. Proc. 66: 513-517. 1959.

Fifteen ponds were treated with toxaphene concentrations that varied from 0. 01 to 0. 1 parts per million. Preliminary studies revealed wide variations in the chemical and physical features of the ponds. Approximately 3, 500 pounds of fish were killed. Carp, gizzard shad, and quillback were the most numerous; other species included largemouth bass, bigmouth buffalo, black crappie, black bullhead, bluegill, yellow bass, and channel catfish. Detoxification studies were conducted on five ponds. The first pond detoxified within 90 days; two remained toxic to fishes for 270 days. Factors important to the duration of toxicity are discussed.

State Conserv. Comm., Des Moines, Iowa.

Tarzwell, C. M. POLLUTIONAL EFFECTS OF ORGANIC INSECTICIDES. 24th North Amer. Wildlife Conf. Trans. pp. 132-142. 1959.

Many of the new synthetic organic insecticides are extremely toxic to fish. Endrin, Dieldrin, Toxaphene, Guthion, and DDT are acutely toxic to fish at very low concentrations. Long-term studies with some of these have demonstrated that as the period of exposure is increased, concentrations which are toxic become correspondingly smaller. Amounts of these materials usually applied for the control of forest and agricultural pests, if they are also directly applied to the water surface, are sufficient to decimate aquatic populations. Many of these materials have a long residual toxicity in the soil, and runoff from treated areas has been toxic to fishes in several instances. Extensive kills have already resulted in several areas. The widespread use of these materials is, therefore, creating an immediate pollution problem.

The effect on the biota of continuous exposure to low levels of these materials is yet to be determined. Indications are that it can become a serious problem. Since the toxicity of some of these materials varies widely with the species, acute toxicities must be determined for all important species of related groups. Furthermore, concentrations which are safe under conditions of continuous exposure must be determined. Since the toxicity of these materials is not markedly affected by water quality this can perhaps be effectively accomplished by the development of application factors which can be used with median tolerance limits (TL_m) values to indicate safe concentrations for continuous exposure.

Studies should also be made with each of the new insecticides to determine the toxicity of runoff and seepage water from various soil types, slopes, and vegetative covers for different dosages, formulations, and modes of treatment.

There are certain measures which can be taken to lessen or abate stream pollution due to the widespread use of the new synthetic organic insecticides. These are as follows: (1) Use spot control in preference to broadcasting the toxicant over wide areas; (2) when a certain pesticide is to be used for the control of a particular species, determine the smallest dosage which is effective for the control of that species and do not exceed it in control operations; (3) before beginning extensive control operations, determine the formulation method of application, and the material which is least toxic for other members of the biota; (4) if the above has been done and it is found that in spite of this all the efficient pesticides will seriously affect other organisms in the biota, give consideration to the use of a material which while less effective for the control of the pest species is not so toxic or is relatively nontoxic to other important organisms; and (5) use narrow spectrum or specific pesticides.

In the past the demand has been for more toxic and broad spectrum insecticides. This is due to the development of resistance in some species and to the desire to take care of all pest problems with one treatment. The use of such materials usually results in harm to a considerable portion of the biota. It is believed that this trend must be reversed and that there must be a concentration on the development of narrow spectrum or specific insecticides if serious future pollution problems are to be avoided. The development of a specific material for a given species would allow its widespread use without harm to other organisms. It is believed that such narrow spectrum or specific pesticides must be developed if we are to preserve our water resources in many areas.

Sanit. Engin. Cent., U.S. Public Health Serv., Cincinnati, Ohio.

Upland Wildlife

Sheldon, W. G. COVER MAPPING A FIVE-MILLION-ACRE STATE FROM AERIAL PHOTOGRAPHS. 24th North Amer. Wildlife Conf. Trans. pp. 313-321. 1959.

Aerial photographs at a scale 1/20,000 were made of the state of Massachusetts in 1951 and 1952 when the deciduous trees were in leaf. A unique project of cover mapping the entire state down to areas as small as 10 acres from these photographs was undertaken. No area of over 5,000,000 acres of diverse habitat has ever been cover mapped in such detail. The mapping included symbols for forests according to species, height and density, open lands including abandoned fields, agricultural lands, orchards, abandoned orchards, cranberry bogs, shrubs swamps, and other categories. Wetlands of all types made up the third classification group. By using accepted photogrammetric techniques, the typing on the aerial photographs was transferred to the 186 geologic survey maps of the state at a scale of 1/31,680 and reproduced in some quantity. The file copies were colored according to vegetative types.

To a map showing both planmetric and topographic detail has been added the invaluable information on the exact location and juxtaposition of all types of cover has been tabulated for every town and county in the state. The cost of the entire project, excluding the cost of photography, was approximately 1/2¢ per acre. One completed colored map represented 50 skilled man hours of labor.

The utility of this tool in the hands of game administrators and wildlife biologists is proving very high. It is possible to evaluate game habitat on a broad basis with the information on the types. The stages of forest succession determine suitability of habitat for various upland species. Such stages are clearly shown on these maps. Census lines for such upland species as quail, ruffed grouse, and woodcock are first laid out on these maps and later field checked. Habitat types on land available for purchase by the state is known. The location of small wetlands for development of water-fowl areas is depicted. Countless man hours of field work was saved by being able to do preliminary intelligent planning in the office. Secondary uses of these maps for other public agencies have proved many fold. Foresters, agricultural economists, fruit growers, soil conservationists, watershed agencies, town and regional planners, land tax agencies, commercial lumber concerns, and others have created a demand for copies of these maps, and the tabulated type area statistics which are now available.

U. Mass., Amherst, Mass.

Vohs, P. A., Jr. WIDE-ROW CORN AS A GAME MANAGEMENT TOOL. 24th North Amer. Wildlife Conf. Trans. pp. 272-276. 1959.

The value of "edge" and diversification of habitat have long been understood as primary principles of farm land management for wildlife. Wide-row cornfields provide both of these. Changes in vegetation, constituting "edge," occur throughout the fields minimizing the field border effect and allowing game species to make use of the interior as well as the borders of the wide-row fields. Diversification occurs in wide-row fields because forage or meadow crops are produced in conjunction with row crops. Concentrated grains and forage are available in the same field and protective cover is provided.

Food is more abundant in the wide-row fields than in conventional corn plantings when both annual seed producing plants and forage species are included in the interseeding mixture. Seeds and vegetative forage are provided for increased numbers of wildlife over a longer period of time. The carrying capacity of a farm for game will be increased if wide-row corn replaces conventional plantings.

The establishment of grasses and legumes the previous summer in the wide-row fields will allow early spring development of the plant species. This spring growth could possibly provide cover suitable for early spring nesting of pheasants and cottontails. Cover provided by the developing interseeding during the summer of establishment might be suitable for late nesting.

Public and private shooting preserves could benefit by planting corn in wide-rows and interseeding with grass and legumes in place of standard-interval cornfields. The additional food, cover, and diversification of habitat could possibly improve conditions for native as well as for released birds. In a sense, wide-row corn used in this manner would increase and improve upon the capacity of the land to support hunting.

Management programs of wildlife refuges could be benefited by wide-row corn culture. Additional forage could be provided on waterfowl refuges where populations of puddle ducks and geese are limited by the food producing capacity of refuge lands. On pheasant areas additional loafing, feeding, and nesting cover could be provided. More acreage in this type of semigrassland agriculture might provide part of the answer to saving the diminishing prairie chicken population in Illinois where row crops replaced the growing of redtop grass seed.

An improved agricultural practice, wide-row corn should be acceptable to the farmer. Though the problem of adjusting farm equipment is present, the benefits derived far outweigh this disadvantage. Soil protection, soil improvement, maintenance of yield nearly equal to standard corn culture, and improved systems of rotation are some of the advantages which are available when wide-row corn replaces the conventional method. More forage and pasture lands would be available without removing any acreage from row crops. Wide-row corn can be advocated as a sound agricultural practice and will provide a wildlife management tool for improving habitat in row crop fields with a minimum of special effort on the part of the farmers.

Coop. Wildlife Res., Southern Ill. U., Carbondale, Ill.

Uhlig, H. G., Anderson, W. G., and Hamor, W. H. (INFORMATION SERIES OF LAND MANAGEMENT FOR GAME SPECIES.) U.S.D.A., S.C.S., Milwaukee, Wis. 1959-1960. Abstract from Wildlife Rev. 98:16. 1960.

A series of information sheets which should prove helpful to farmers and sportsmen who are interested in doing something for wildlife. Each has been abstracted from authoritative reference which are cited. General notes, land management practices, range, nesting cover, food, and a geographic range map is provided for each species. Each publication consists of a 2-page (single-sheet) processed leaflet. The first three plus number five are by Uhlig. Numbers four, six, seven, and eight are by Uhlig and Anderson. Numbers nine through thirteen are by Uhlig and Hamor.

BI- 1	Land Management for Hungarian Partridges	1959
-----	Land Management for Ring-necked Pheasants	"
-----	Land Management for Bobwhite Quail	"
BI- 4	Land Management for Cottontail Rabbits	"
BI- 5	Land Management for Tree Squirrels	"
BI- 6	Land Management for Ruffed Grouse	"
BI- 7	Land Management for Ducks	"
BI- 8	Land Management for Muskrats	"
BI- 9	Land Management for Prairie Chickens	1960
BI-10	Land Management for Sharp-tailed Grouse	"
BI-11	Land Management for Wild Turkey	"
BI-12	Land Management for Mourning Doves	"
BI-13	Land Management for White-tailed Deer	"

SCS, USDA, P.O. Box 358, Fergus Falls, Minn.

Klonglan, E. D., Robbins, R. L., and Ridley, B. L. EVALUATION OF EFFECTIVENESS OF PHEASANT FLUSHING BARS IN IOWA HAYFIELDS. Iowa Acad. Sci. Proc. 66: 534-552. 1959.

A three year study on 394 acres of hayfields revealed an overall reduction in hen mortality of 38 percent through the use of flushing bars. This was significant at the .01 probability level. For the individual years, only 1954 showed a significant reduction in hayfield mortality, the observed 54 percent decrease being significant at the .05 probability level. The bars were most effective in flushing hens that were in the hay but not sitting on the nest at the instant before the mower passed. A large proportion of hens on the nest was saved if incubation had not been started. Flushing bars were more effective in the afternoon than the forenoon hours. Effectiveness was well correlated with the condition of the hay crop; as the density and height of the hay increased, the effectiveness of the bar decreased rapidly. A possible "security threshold" factor related to the density of the cover, which may influence the likelihood a hen will flush, is suggested. It is not known if the use of the flushing bar actually resulted in additional pheasants in the fall populations; there was no noticeable increase attributable to their use. The principle of "carrying capacity" may act to cancel any initial gain resulting from the use of flushing bars.

Iowa State U., Ames, Iowa.

Baskett, T. S., and Tomlinson, R. E. BOBWHITES AND BENEFIT PAYMENTS. 24th North Amer. Wildlife Conf. Trans. pp. 289-303. 1959.

According to an earlier study, yearly increases in quail followed a five-year program of farm improvement on the 2,070-acre West Ashland area in Missouri. This program of pond construction, liming, fertilizing, field-border improvement, and other practices, was speeded by double benefit payments. It was terminated in 1949.

Our study conducted in 1957-58 showed that liming, fertilizing, and many other such practices had been continued on this area and were often supported by ASC benefit payments. However, with no guidance by game managers, few practices now were intended for, or were directly beneficial to wildlife. Although the West Ashland area retained much good game cover in 1957-58, it was being farmed more intensively. Fall quail populations dropped from 751 in 1950 to 305 in 1958. A general decline in the locality may have been partly accountable.

Between 1950 and 1957-58, the New Salem area, located nearby, had undergone drastic reductions in cover and food. Entire systems of wooded hollows had been bulldozed, and several farms were now managed intensively for livestock. Liming, fertilizing, and pasture renovation were regular practices, often with the aid of benefit payments. On 960 acres, fall quail populations dropped from 174 in 1950, to 65 in 1958.

In 1958, Soil Bank participation was limited to the West Ashland area where game conditions were already good. But on the New Salem area, where cover of any kind was needed desperately, land was considered too productive to retire from heavy grazing and tillage.

The history of the two areas since 1950 clearly illustrates that without consideration for wildlife, benefit payments and practices they encourage may be of little value for wildlife. At West Ashland, at best, these practices only partially counteracted harmful effect on game of more intensive farming. At New Salem, they went hand in hand with virtually complete destruction of game habitat.

Coop. Wildlife Res. Unit, U. Mo., Columbia, Mo.

Loveless, C. M., and Ligas, F. J. RANGE CONDITIONS, LIFE HISTORY, AND FOOD HABITS OF THE EVERGLADES DEER HERD. 24th North Amer. Wildlife Conf. Trans. pp. 201-215. 1959.

Results are reported from an investigation of Everglades deer. Studies were confined primarily to the 725,300-acre Everglades Wildlife Management Area and were initiated to acquire a knowledge of the ecology of Everglades deer to serve as a basis for management. Intensive field work began in January 1956.

Everglades deer occupy a range encompassing about 2,000 square miles of seasonally flooded fresh-water marsh in southeastern Florida. Principal vegetational components are the sawgrass, wet prairie, slough-aquatic, and tree island communities.

Surface water covers the range the greater portion of most years but during drought periods the area is dry and often swept by fire. Fire is generally beneficial, however, as it creates conditions that encourage the establishment of many important deer food plants and checks plant succession toward the less desirable associations.

During unusually wet years water depths may exceed three feet over an extensive region. When these high water levels persist through the winter and spring months range conditions become critical as the deer concentrate on elevated sites and rapidly deplete available nutritious forage. Mortality due to starvation and disease induced by malnutrition are serious decimating factors during these periods. Thus, periodic critical range conditions with attendant mortality is the adjusting mechanism that prevents any appreciable increase in mean population numbers.

Fall adult sex ratios average 1 buck to 2.06 does. The ratio of adult does to number of young varied from 1.0: 1.74 in favorable years to 1.0: 0.66 during unfavorable periods. Average annual productivity was estimated to be 31 percent. Aerial census in 1956 indicated a preseason management area population of about 7,000 deer. The Lauckhart census showed a post season population estimate of 7,800 in 1958. This suggests a deer population of approximately 14,000 animals for the 2,000-square mile range.

Browse studies and rumen sample analyses show that Everglades deer eat a wide variety of plants (51 species identified) but about 10 species comprise the bulk of the year-round diet. These key forage species are Nymphaea odorata Ait., Crinum americanum, Salix amphibia, Smilax spp., Jussiaea peruviana, Sambucus Simpsonii, Rivina humilis, Dicliptera assurgens L., Baccharis glomeruliflora, and Osmunda regalis.

Fla. Game and Fresh Water Fish Comm., Tallahassee, Fla.

Besser, J. F., and Welch, J. F. CHEMICAL REPELLENTS FOR THE CONTROL OF MAMMAL DAMAGE TO PLANTS. 24th North Amer. Wildlife Conf. Trans. pp. 166-173. 1959.

Three chemical formulations have been developed into commercially available repellent products that are highly effective in protecting woody plants from damage by rabbits and hares, and which also are useful in protecting plants from damage by such mammals as deer, meadow mice, beavers, and livestock. The active ingredients of these formulations are trinitrobenzene-aniline, zinc dimethyl dithio carbamate cyclohexylamine complex, and tetramethyl thiuram disulfide. When formulated with certain latex or resin adhesives and suitable additives, they have protected plants for as long as 1 year in some field tests. One or more of these products should soon be available at many farm and garden supply stores throughout the country.

Wildlife Res. Lab., Bur. of Sport Fisheries and Wildlife, Denver, Colo.

Leedy, D. L. PESTICIDE-WILDLIFE PROBLEMS AND RESEARCH NEEDS. 24th North Amer. Wildlife Conf. Trans. pp. 150-165. 1959.

This paper points out the tremendous growth of chemical pesticide industry since 1940; reviews some of the findings from the relatively limited pesticide-wildlife research which has been conducted, especially as pertaining to effects of DDT on fish and wildlife; cites some of the more spectacular losses of fish and wildlife resulting from pesticide applications; lists some guidelines for use as fish and wildlife protective measures during spraying operations; describes some of the major problem areas and gives samples of endemic or other species of birds and mammals of special interest that may be endangered; briefly reviews current pesticide-wildlife research; and points out additional research needs.

To develop a better understanding and appreciation of the complex pesticide-wildlife relationships and to accomplish pest control with a minimum of fish and wildlife losses, will require greatly increased cooperation. There must be cooperation on the part of the Federal, State, and private agencies concerned, and the coordinated effort of landowners, control operators, research personnel, and administrators. There must be a better exchange of information among entomologists, fish and wildlife biologists, chemists, chemical manufacturing concerns, and operational control personnel. There will always be conflicting opinions with respect to control operations because of divergent interests of people, even in the same community. Alarmism and emotionalism will not resolve these conflicts. We must get the facts and base our actions on these facts.

Bur. Sport Fisheries and Wildlife, Washington, D. C.

Howard, W. E., Fenner, R. L., and Childs, H. E., Jr. WILDLIFE SURVIVAL IN BRUSH BURNS. J. Range Mangt. 12: 230-234. 1959.

Information on wildlife survival of prescribed (controlled) brushland fires was obtained by three methods: (1) 37 rodents and snakes in cages with temperature recording devices were placed in different habitat situations, and the area was control burned; (2) the number of birds and mammels drinking from a spring was counted both before and after the area was burned; and (3) the behavior of wild animals was observed from an observation point within the fire.

The cage temperature lethal to rodents was somewhere between 138° and 145° F. Results indicate that there was little chance of wild vertegrate animals getting caught in a situation that would lead to their death during such fires. Most species of vertebrates benefit from control burns, because the habitat then becomes more favorable.

U. Calif., Davis, Calif.

Lyon, J. L. AN EVALUATION OF WOODY COVER PLANTINGS AS PHEASANT WINTER COVER. 24th North Amer. Wildlife Conf. Trans. pp. 277-289. 1959.

The field investigation was designed to answer two basic questions about woody windbreak plantings and their relationship to wildlife. First, does such cover provide effective winter shelter for pheasants; and, second, are values received, if any, consistent with the investment of habitat-improvement funds required? Although neither question was answered conclusively, there was ample evidence that the plantings examined in Colorado were not adequate in either respect.

Pheasant use of plantings during the winter was found to be at least partially dependent on both the juxtaposition of good herbaceous cover and the proclivity of individual plantings for collecting snowdrifts. It appeared that pheasant use could never be expected in plantings not bordered by wheat stubble or weedy areas. In addition, those plantings in which deep snowdrifts had collected were avoided by birds.

During the midwinter period, when pheasant mortality due to weather is most likely to occur, the combined influences of temperature, precipitation, and wind were almost entirely responsible for periodic fluctuations in pheasant use of deciduous plantings. In the three winters, 67.8 to 93.3 percent of the variation in use-ratings was mathematically related to these three factors. More important, it was shown that the strong and consistent pheasant reactions elicited by wind and, to a lesser extent, precipitation were the reverse of those desired. That is, throughout the study, pheasants deserted deciduous plantings in response to high winds and heavy snow.

The response of pheasants to winter weather conditions showed that deciduous woody windbreaks, considered simply as winter cover, probably have no justification in pheasant management. Obviously, if the objective of winter cover is to preserve a seed-stock of birds which will replenish a decimated population, any cover which is avoided by pheasants during blizzard conditions cannot be considered effective.

Nevertheless, this does not eliminate the possibility that woody cover can serve an important function in wildlife management. This study was concerned with only one game species in a single region during the winter period.

Colo. Game and Fish Dept., Denver, Colo.

Wetland Wildlife

Nelson, U. C., and Hansen, H. A. THE CACKLING GOOSE--ITS MIGRATION AND MANAGEMENT. 24th North Amer. Wildlife Conf. Trans. pp. 174-187. 1959.

From a harvest point of view, the crackling goose is in a healthy condition and it appears that this situation will continue as long as the current restrictive measures are necessary on the West Coast to protect other subspecies of Canada geese occupying the same habitat.

The status of the cackler could become quite vulnerable on the breeding grounds, however, largely because of inherent characteristics of the species itself. It is a highly gregarious bird, almost colonial in nesting and brooding habits. Its present breeding range is quite restricted along a narrow belt of low coastal tundra. It lays a relatively small clutch of eggs and consequently raises a small brood although nesting success has been quite high. Olson (1951) found cacklers in densities up to 146 nests per square mile averaging 4.02 eggs per nest and 3.7 young per brood. Hatching success under these conditions, based upon 124 completed nests, was 73 percent.

One of the primary management needs is to assure protection of the breeding ground, all of which lies within the long proposed Yukon-Kuskokwim Game Management Area. Destruction or impaired efficiency of any part of this key habitat would immediately be reflected in a dwindling cackling goose population.

Indiscriminate oil development, large-scale reindeer activity, pollution or other man-induced factors could effect serious consequences on the breeding grounds.

Another primary management tool should be the restoration of ancestral breeding grounds on the Aleutian Islands. When fox farming became profitless, the Aleutian Island leasees abandoned their holdings and allowed the foxes to become feral. Under these conditions ground-nesting birds were doomed. If a seed stock of cacklers, and other waterfowl, have survived on unmolested islands, perhaps they can still come back on the larger, primary nesting islands once the foxes have been eradicated.

U.S. Fish and Wildlife Serv., Bur. Sport Fisheries and Wildlife, Juneau, Alaska.

Collias, N. E., and Jahn, L. R. SOCIAL BEHAVIOR AND BREEDING SUCCESS IN CANADA GEESE (BRANTA CANADENSIS) CONFINED UNDER SEMI-NATURAL CONDITIONS. Auk 76: 478-509. 1959.

The breeding behavior, vocalizations, and dominance order of Canada Geese (Branta canadensis) confined under semi-natural conditions at Horicon Marsh, Wisconsin, are described in some detail, with special reference to social interactions between individually marked birds.

Pair formation depends both on specific preferences and on dominance relations between individuals. The nest site is selected by the female of a pair; she is escorted in the search by the more aggressive male. Repeated attempts at establishment on suitable nest sites and repeated eviction by more dominant birds is the rule for birds of relatively low dominance status.

When regular incubation begins, copulation ceases. After hatching, the goslings usually spend a day in the nest before leaving. During their first week goslings are apt to become lost, and are readily adopted into some other family. However, the early development of agressiveness against strangers by the goslings, as well as by their parents, tends to preserve the integrity of each family.

Loss in productivity of the breeding colony was very largely due to the territorial behavior of the birds themselves resisting the crowded conditions. In the breeding season of 1952 at the Horicon Marsh colony, about 70 percent of the theoretical or potential increase was lost. In turn, this loss was traced mainly to: (1) Failure of birds to pair effectively; (2) failure to lay and incubate eggs; and (3) to loss of the clutch once laid. All generally as a result of domination by other birds.

U. Calif., Los Angeles, Calif.

Rogers, J. P. LOW WATER AND LESSER SCAUP REPRODUCTION NEAR ERICKSON, MANITOBA. 24th North Amer. Wildlife Conf. Trans. pp. 216-224. 1959.

In the spring of 1957, water levels were high in the potholes near Erickson, Manitoba, and 51 pairs of lesser scaup on a square mile study area produced 225 young. Subnormal precipitation during the following winter left water levels low at the onset of the 1958 breeding season. Peripheral nesting cover, flooded in 1957, was dry in 1958, and emergent shoreline vegetation was separated from water by mud flats. On the same square-mile study area, 65 pairs produced only 20 young. Low water levels and reduced production were also observed on two nearby lakes and on two transects crossing the district. Reduced production was observed in other diving ducks, but river ducks showed no evidence of this.

Greater vulnerability of nests to predators and failure of birds to renest in dried-out edge cover probably account for the severe decline in production of lesser scaup.

A bag talley of 4,765 ducks shot on the Delta Marsh shows that the lesser scaup was the No. 1 bird in the bags, probably because of its greater accessibility in a marsh reduced by drought. The ratio of young per adult female was smaller than in any other year in lesser scaup, redhead, canvasback, and mallard. For the first time, adults outnumbered young in the mallard bag. The diving duck kill was proportional to populations on the marsh. In the mallard, however, the kill declined as the season advanced despite a continuing high resident population.

U. Mo., Columbia, Mo.

Scheffer, P. M. FARMING FOR WATERFOWL IN THE PACIFIC FLYWAY. 24th North Amer. Wildlife Conf. Trans. pp. 238-242. 1959.

Farming for waterfowl implies that modern farming technologies are employed in the annual production of a dependable, high-quality food crop for waterfowl. As this system is understood by the landowners, it is replacing the hit-or-miss methods of food plant selection and establishment that have usually resulted in failure. The waterfowl food crop on any "farmed" acreage can now be predicted in terms of pounds of food or numbers of duck-days feeding per acre.

Farming for waterfowl involves site selection and preparation, the selection of adapted plant materials, seedbed preparation, proper seeding methods, fertilization, irrigation, and crop management.

The areas developed for waterfowl farming involve a system of individual units. The units, in irrigated areas, are generally separated by dikes or "checks" laid out on contours established at two-tenths of a foot vertical interval. Other units are established as level, irregular-shaped diked basins. Either system allows uniform irrigation of the food crop during the growing season. In non-irrigated areas, a less-uniform topography is usually found within the diked basins.

Waterfowl food plants are seeded on well-prepared seedbeds. The seeded areas are fertilized. Irrigation may or may not be necessary, depending on climatic and soil moisture circumstances. The seeding date is time to permit complete maturity of the plants as close to the period of fall waterfowl migration flights as possible.

Two plants established for standard use in soil conservation district cooperative waterfowl farming projects on marginal lands are: Barnyard grass (Echinochloa crusgalli and varieties) and common sudangrass (Sorghum vulgare sudanense). Field corn (Zea mays) is also commonly used on higher capability lands within its growth range. Yields of 1,750 pounds of seed per acre of barnyard grass have been obtained on the alkaline, non-agricultural soils of the Mojave Desert. Sudangrass has produced 1,500 pounds of seed per acre on poorly-drained Williamette Valley soils. On the basis of a 4- to 6-ounce daily food requirement for a duck, Oregon and California private land waterfowl farming projects are annually providing from 4,500 to 6,500 duck days feeding per acre.

Fall and winter flooding of waterfowl fields is accomplished by pumping, stream diversion, or seasonal rains. The field dikes are designed to accommodate from two to sixteen inches of water. Drains are provided for each diked unit to permit complete water removal following waterfowl use.

A second type of waterfowl area development is concerned with marshlands. Marsh areas occasionally occur naturally or are artificially developed in connection with an individual waterfowl farming project.

The fish and Wildlife Service has classified over 600,000 acres of land in the Pacific Flyway as fresh, saline, or salt marsh. Much of this land is in private ownership.

An analysis has been made of economic data obtained from private land development for waterfowl projects on the Pacific Coast. These data indicate that lands of marginal agricultural value can profitably be used for waterfowl as a part of the farming or ranching enterprise.

A unique feature of the Conservation Reserve Program provides that wildlife may be the only harvestable crop that can be taken from lands under contract. Thus, under certain hunting lease agreements, farming for waterfowl under the Conservation Reserve Program can become a profitable farm enterprise.

Farming for waterfowl in areas of alkaline soils is also being carried out as a temporary land use program. This is done during the years of land conditioning before profitable cropping can be put into effect. The soil leaching program involves the impoundment of fresh water over the land surface for several months each year for a period of two or more years. The leaching process is facilitated by the use of salt-tolerant plants such as barnyard grass or barley. Where these plants are used, excellent waterfowl feeding or harvest areas are created.

SCS, USDA, Berkeley, Calif.

Harris, S. W., and Marshall, W. H. GERMINATION AND PLANTING EXPERIMENTS ON SOFT-STEM AND HARD-STEM BULRUSH. J. Wildlife Mangt. 24: 134-139. 1960.

Five storage and three germination conditions were tested on three lots of soft-stem bulrush and one lot of hard-stem bulrush seed. No appreciable germination was obtained after 3, 6, and 7 months' storage in any of the tests. Manipulation of illumination and moisture during storage increased germination percentages somewhat. Seed stored under natural conditions had the highest germination percentages. Soft-stemmed bulrush seed which had been fed to a mallard duck and recovered from the droppings was reduced in its germination compared to seed which had not been fed. Five lots of seed were planted in the spring and no seedlings became established. In contrast, all of four plantings made in the fall after the growing season developed heavy stands of seedlings the following spring and summer. Two methods of combining drawdown operations and bulrush seeding are suggested.

Paper 4228 Sci. J. Ser., Minn. Agr. Expt. Sta., St. Paul, Minn.

Cottam, C., and Glazener, W. C. LATE NESTING OF WATER BIRDS IN SOUTH TEXAS. 24th North Amer. Wildlife Conf. Trans. pp. 382-395. 1959.

Little information is available on waterbird production and late nesting in South Texas. The commonly held opinion is that marsh or waterbird nesting, and especially late nesting, is so uncommon here that it is quite unimportant. The facts show rather conclusively that when environmental conditions are favorable there is substantial nesting in this section of the state, and much of it occurs surprisingly late in the season. This study has been restricted to the rather late summers of 1957 and 1958 at a series of five shallow natural lakes aggregating about 242 acres of marsh and water on the 7,800 acre Welder Wildlife Foundation Refuge located some thirty miles north of Corpus Christi and ten miles northeast of Sinton, Texas.

The authors made the following conclusions: (1) Nesting studies in late summers of 1957 and 1958 at the 7, 800 acre Welder Wildlife Refuge reveal that waterbird nesting is substantial in South Texas, and that nest abundance varies with habitat conditions. (2) In the late summers of 1957 and 1958, 513 nests of tree ducks, coots, and Florida and purple gallinules, pied-billed and Mexican grebes, least bittern, and green herons were found on the Welder refuge lakes. Other water-loving species nested near the periphery of the lakes. (3) Information on ecology and nest history is given as is also details of nesting abundance and success. (4) Parasitism was common with the observed species of Rallidae. (5) The covering of grebe eggs gave added protection and helped in incubation. And (6) the importance of optimum or favorable environment as a stimulus to production probably has not been fully realized.

Welder Wildlife Found., Sinton, Tex.

Dillon, O. W., Jr. FOOD HABITS OF WILD MALLARD DUCKS IN THREE LOUISIANA PARISHES. 24th North Amer. Wildlife Conf. Trans. pp. 374-382. 1959.

Hard seeds occurring in mallard gizzards are misleading as to importance as food. Jamaica sawgrass, squarestem spikesedge, Schreber watershield, stonewort, waterlilies, and dodder are apparently hard enough to serve as grit and to remain in the gizzard for a period of several days or even weeks before being worn away.

Mallards in the area under discussion depend heavily upon foods produced on agricultural lands. Management of rice stubble fields for mallards is extensive throughout the rice-growing area of Louisiana. Acre for acre, crop residues and weed seeds associated with rice culture produce quality foods in amounts far in excess of that produced by natural marsh land. Management techniques are being developed for the production of high quality duck foods, such as browntop millet and signalgrass, on rice lands in the years that the land is fallowed.

A high percentage of Louisiana mallards winter on or near agricultural land.

Fields, where water is held on the land until the birds return to the north in the spring, are important courting grounds as well as feeding areas. When the hunting season is over the birds use agricultural lands for feeding, loafing, and courting. Within a short time after the hunting season closes, the large daily flights from the fields to the marshes cease.

This observation leaves little doubt that mallards in the section of Louisiana studied prefer rice fields to marshes for feeding and loafing. They go the marshes in large numbers primarily because of human disturbance at the rice fields--not because the marshes are preferred habitat.

This study does not depreciate the value of Louisiana marshes for mallards. It does, however, demonstrate the high value of rice field crops for mallard food and points out the need for management of rice field areas, as well as for the management and preservation of marshes.

The rice-growing area of Louisiana, in combination with its vast marshes, is now capable of wintering a larger population of mallard than that section of Louisiana was able to support in its original condition. With skilled attention to the management of the rice-growing area and the preservation and management of the better fresh-water marshes, we can winter and send back to the nesting grounds more mallards in better breeding condition than was possible before the advent of rice growing.

SCS, USDA, Rosenberg, Tex.

Hoffmeister, D. F. THE FUTURE STATUS OF THE NUTRIA, FUR-BEARING RODENT, IN ILLINOIS. Ill. State Acad. Sci. Trans. 51(3 & 4): 48-50. 1958.

The nutria is native from Paraguay to the Straits of Magellan. It is closely related to the guinea pig and porcupine and is only distantly related to the muskrat. An aquatic rodent weighing as much as 25 to 35 pounds, it resembles a beaver, but has a round, not paddle-shaped, naked tail. The mammary glands are located on the sides rather than on the abdomen. Nutrias are docile and less wary of humans than muskrats or beavers. In many places where nutrias have been liberated, they are active during the daytime; in other places they are active only at night.

Under ideal conditions, nutrias feed almost entirely an aquatic vegetation along the edges of marshes and ponds, or out in these bodies of water. They prefer cattails, reeds, and various other types of aquatic vegetation. Their nests are usually made among reeds and sedges and are built by piling together the cut twigs of these plants, forming a somewhat bird-like nest. Sometimes the animals burrow into banks. The burrows are short and from eight to nine inches in diameter. Nutrias will not eat the algae or water mosses found in many of our ponds and swamps. They are said to clear out this type of "vegetation" but such does not seem to be the case.

Under favorable conditions these animals will breed the year around and each adult female may produce two or three litters each year with an average of five young in a litter. The young are precocial and care for themselves effectively a few hours after birth. They weigh about one-half pound at birth, grow rapidly, and reach sexual maturity in less than six months. Under favorable conditions, nutrias are as prolific as rabbits!

In many parts of the southern United States, nutrias have become such pests that numerous requests are being made for practical methods of eliminating them. There is no practical method known for removing them. In some states, such as Texas, they can be killed legally at any time and by any method. Nevertheless, they still continue to increase and remain a pest.

Nutrias have not only failed to remove moss from clogged ponds, but their burrowing activities have weakened earthen dams and levies. Their extensive utilization of shore vegetation has forced the native muskrats out of some areas and destroyed valuable waterfowl habitat.

It seems apparent that what has happened in Texas and other southern states with regard to nutrias in the wild may very well happen in Illinois. Although it might be the intention to keep all nutrias in fenced fur farms, it is predictable that circumstances will enable nutrias to escape. It seems probable that in Illinois they would establish themselves along drainage ditches and around ponds in such a fashion that they would be a real menace to the native muskrat and waterfowl. They would compete with other mammals living in marshy areas, including the swamp rabbit, and in general become so numerous as to be a threat to many kinds of wildlife.

Because of the low economic gains from nutria-farming and because of the probable undesirable effects of introducing another non-native mammal which may replace a valuable fur-bearer, it is advisable to exercise careful controls over any importations and plantings of nutria within the state of Illinois.

U. Ill., Urbana, Ill.

SUPPLEMENT

Problems Affecting Application

Glover, D. V., and McAllister, D. R. TRANSMISSION STUDIES OF ALFALFA WITCHES' BROOM VIRUS IN UTAH. Agron. J. 52: 63-65. 1960.

The leafhopper, (*Scaphytopius acutus* Say) was the only insect, of six tested, found to be a vector of the alfalfa witches' broom virus in Utah. Transmission attempts with three dodder species failed to transmit the virus from alfalfa to alfalfa.

J. Paper 86, Utah Agr. Expt. Sta., Logan, Utah.

Julander, O., Low, J. B., and Morris, O. W. INFLUENCE OF POCKET GOPHERS ON SEEDED MOUNTAIN RANGE IN UTAH. J. Range Mangt. 12: 219-224. 1959.

Two typical overgrazed tarweed flats heavily infested with pocket gophers were reseeded to a mixture of grasses. On one area the gophers were closely and effectively controlled; on the other they were left undisturbed. An excellent stand of grass seedlings emerged on both areas. Studies from 1952 through 1957 showed a downward trend of grass stands and yields on the uncontrolled area and establishment and maintenance of a full grass stand on the controlled area. Production of seeded grasses from 1953 to 1957 averaged 355 pounds per acre on the uncontrolled area, and 1, 195 pounds per acre on the controlled area. Occurrence of grass plants on 1/4 sq. ft. plots remained high on the controlled area but showed a downward trend on the uncontrolled area.

Pocket gophers damaged seeded grass stands on the areas studied in the following ways: (1) Their winter casts partially seal the soil against water infiltration; (2) their tunnels aerate the soil and thus aggravate summer drought; (3) they undermine plants and destroy or weaken their roots; (4) they often undermine seedlings and small plants and pull them into their tunnels for food and nesting materials; (5) their mounds and particularly their winter casts, cover and often kill young plants; and (6) under cover of snow in winter or early spring they eat or otherwise destroy root crowns and stem bases of well-established grass clumps.

Some degree of gopher control appears necessary for establishment and maintenance of good seeded stands of timothy, orchardgrass, tall oatgrass, and smooth bromegrass on depleted range having dense populations of pocket gophers.

Intermountains Forest and Range Expt. Sta., FS, USDA, Ogden, Utah.

Den Dulk, P. R. SYNTHETIC DETERGENTS IN SEWAGE SLUDGE. Netherland J. Agr. Sci. 8: 139-148. 1960.

Synthetic detergents may get into the soil if sewage sludge is used as a fertilizer and if waste or water infected with waste water, is used. Investigations were made as to the effects of this on the growth of plants. When the soil was poor in adsorbing matter (clay and humus), damage occurred when only small quantities were used. If, however, the soil was rich in adsorbing matter, the damage was slight. The cause of the damage may be a disturbance of the water management in the soil.

Hort. Advisory Serv. in Matters Relating to the Soil, Wageningen, The Netherlands.

American Society of Agricultural Engineers. AGRICULTURAL ENGINEERS YEARBOOK 7th, Ed. Amer. Soc. Agr. Engin. 400 pp. 1960.

This 1960 yearbook is the 7th edition and has a lot of material that could be used by farm planners, especially the following articles:

1. Draft and Power Requirements of Crop Machines	p. 99
2. Capacity of Crop Machines	p. 100
3. Cost of Use of Crop Machines	pp. 101-103
4. ASAE Data: Hay Drying	p. 105
5. ASAE Data: Grain Storage	pp. 106-115
6. ASAE Data: Feed and Water Requirements of Livestock	pp. 118-119

7. Design and Construction of Tile Drains in Humid Areas pp. 136-145
8. Minimum Requirements for the Design, Installation and Performance of Sprinkler Irrigation Equipment pp. 157-158

Amer. Soc. Agr. Engin., P.O. Box 229, St. Joseph, Mich.

Soil-Plant Relationships

Alban, L. A., and Kubota, J. A STUDY OF EXTRACTABLE SOIL COBALT IN SOILS OF THE SOUTHEASTERN UNITED STATES. Soil Sci. Soc. Amer. Proc. 24: 183-185. 1960.

The relationship between 2.5% acetic acid-dithizone extractable soil cobalt and the amount of cobalt in black gum leaves, a cobalt indicator, was investigated for 71 widely distributed soils of the southeastern United States. The soil samples were from both good areas and areas where cobalt deficiency in ruminants would be expected on the basis of previous analyses. The extractable cobalt values appeared to separate the Ground-Water Podzols, the Humic-Gleys and the Low Humic-Gleys from the better drained Regosols and Red-Yellow Podzolic soils studied. At comparable cobalt concentrations in the black gum, the extracted cobalt was less from the imperfectly to poorly drained soils than from the well-drained soils. For each of the two broad groups of soils, a significant correlation was obtained between extractable soil cobalt for the A_1 horizon and the cobalt concentration in the black gum. Because of the variability in horizon thickness among the different soils, the cobalt values were calculated for the 0- to 6- and 0- to 12-inch depths. The correlation between these values and plant cobalt was also good. The acetic acid-dithizone extractable cobalt appears useful in indicating areas of potentially low soil cobalt in the Southeast where deficiency in cattle or sheep might be a problem.

Agron. Paper 485, N. Y. State Col. Agr., Cornell U., Ithaca, N. Y.

Rutherford, B. E., and Pretty, K. M. THE NUTRITIVE VALUE OF CORN AND SOYBEANS AS INFLUENCED BY SOIL TREATMENT. Agron. J. 52: 27-29. 1960.

The Ca:P ratio of the bone of albino rats was altered by feeding corn and soybean grain from soil fertilized with relatively large amounts of lime, P, and K. Weight gain and N digestibility were not related to soil treatments. The chemical composition of the grain was not appreciably changed by soil treatment, except for a substantial increase in P content with P fertilization.

Mich. Agr. Expt. Sta., East Lansing, Mich.

Pickett, E. E. MINERAL COMPOSITION OF MISSOURI FEEDS AND FORAGES. Mo. Agr. Expt. Sta. Res. B. 724, 16 pp. 1960.

Samples of alfalfa were collected in the years 1954, 1956, and 1957 from 59 locations in 12 counties within the chief alfalfa-producing areas of Missouri. They were analyzed for moisture, ash, nitrogen, phosphorus, potassium, calcium, magnesium, iron, manganese, boron, cobalt, copper, molybdenum, and zinc.

Calcium content was higher in samples from the alluvial soils than in others. Manganese was lower and molybdenum much higher in these alluvial soils than in others.

Cobalt content was lower in alfalfa collected from Marshall, Wabash, Shelby, Grundy, Sharkey, Sarpy, and Menfro than in alfalfa collected from other soils. On these soils, which include the chief soils of northwest Missouri and the alluvial soils elsewhere, 26 percent of the samples were deficient in cobalt for cattle feeding (less than 0.04 p.p.m. cobalt) and 49 percent were deficient for sheep feeding (less than 0.07 p.p.m.).

Many samples were low in boron. Amounts of the other trace elements, iron, manganese, copper, molybdenum, and zinc, indicated that supplies of these were generally adequate for good plant growth and animal nutrition.

U. Mo., Col. Agr., Agr. Expt. Sta., Columbia, Mo.

Bentley, C. F., Carson, J. A., and Bowland, J. P. FERTILIZERS AND THE NUTRITIVE VALUE OF WHEAT GROWN ON A SULPHUR-DEFICIENT GREY WOODED SOIL. Canad. J. Plant Sci. 40: 146-155. 1960.

Rate of gain, efficiency of food utilization, and nitrogen retention by weanling rats were used as criteria to determine the nutritive value of wheat grown on a sulphur-deficient Grey Wooded soil. All diets were supplemented with minerals, vitamins, and lysine. Grain from an area continuously cropped to wheat-fallow and from an area cropped to a 5-year grain-legume rotation were compared. On Breton l, a Grey Wooded soil, grain is highly responsive to fertilization with nitrogen; and legumes are very highly responsive to sulphur fertilization. Samples were fed from plots receiving the same fertilizer treatments in each cropping system. Fertilizer treatments and cropping systems both caused occasional significant differences, and were associated with some consistent trends for differences, in nutritive value of wheat. In general, the grain was of substantially superior nutritive value when grown following legumes; in one year these differences tended to be greater with fertilizer treatments which increased yields. During the same year fertilization with manure tended to improve the nutritive value of fallow wheat. The animal growth and food efficiency were closely related to the protein content of the foods. There were differences between results obtained in 2 successive years. While the differences may have been due to the effect of seasons or to the biennial application of fertilizers they appeared to be closely related to protein content of the grain, a characteristic which long-time data have shown to be highly variable in grain from the Breton plots.

U. Alberta, Edmonton, Alberta, Canada.

Van Riper, G. E., and Smith, D. CHANGES IN THE CHEMICAL COMPOSITION OF THE HERBAGE OF ALFALFA, MEDIUM RED CLOVER, LADINO CLOVER, AND BROMEGRASS WITH ADVANCE IN MATURITY. Wisc. Agr. Expt. Sta. Res. Rpt. 4, 25 pp. 1959.

Changes in chemical composition and in the yield of the various chemical constituents were investigated with advance in maturity in alfalfa grown alone, an alfalfa-bromegrass mixture, bromegrass grown alone, red clover, and ladino clover during the spring and summer growth periods of 1955 and during the spring, summer, and fall growth periods of 1956 at Madison, Wisconsin.

The highest production per acre of dry matter, fiber, and nitrogen-free extract in the forages was usually obtained at the more mature stages of growth. The highest amount per acre of protein, fat, ash, Ca, and K was usually obtained at less mature stages of growth. The spring growth was more productive than the summer growth.

Alfalfa-alone, the alfalfa-bromegrass mixture, and red clover of the forage studies produced the largest amount per acre of dry matter and of the various chemical constituents during both the spring and summer growth periods, but red clover was somewhat lower in production than the others during the summer. Bromegrass-alone was lowest and ladino clover was generally intermediate in the yield of these constituents. However, ladino clover yielded the least fiber of all the forages during the spring.

The percentages of protein, P, K, and the p. p. m. of carotene generally declined and the percentage of fiber increased with advance in maturity in all forages during both growth periods. The percentages of fat and ash declined with advance in maturity in the forages during the spring but there was not a pronounced trend during the summer. A general trend for the percentages of nitrogen-free extract and Ca was not clearly indicated during either growth period.

Ladino clover was generally the highest and most constant in the percentage of protein at all stages of growth. Bromegrass-alone was the lowest in percentage of protein, while the other forages were intermediate between ladino clover and bromegrass-alone during both growth periods. Bromegrass grown with alfalfa was higher in percentage of protein than when grown in pure stand.

Alfalfa-alone and the alfalfa-bromegrass mixture contained the highest percentage of fiber, ladino clover the least, and red clover and bromegrass-alone were intermediate in fiber content during both growth periods.

Bromegrass-alone contained the highest percentage of fat during both growth periods. During the spring, alfalfa-alone and the alfalfa-bromegrass mixture contained the least fat, while red clover and ladino clover were intermediate. There were no sharp differences in fat percentage during the summer, except for bromegrass-alone which increased sharply in fat content.

Ladino clover, red clover, and bromegrass-alone contained the highest percentage of NFE (nitrogen free extract) during both the spring and summer periods, while alfalfa-alone and alfalfa-bromegrass mixture contained slightly lower levels.

Bromegrass-alone had the highest percentage of ash during both growth periods. The other forages contained somewhat lower percentages of ash but no one forage was distinctly different from the others for any period of time during either growth period.

The legumes contained the highest percentage of Ca during both growth periods. The legumes grown alone and the alfalfa-bromegrass mixture averaged 1.41% Ca during both growth periods, while the bromegrass grown alone and with alfalfa averaged only 0.43% Ca.

There were only small differences in the percentage of P among the forages at any one time.

Bromegrass generally contained the highest percentage of K during both growing periods.

Red clover and ladino clover generally contained the highest p.p.m. of carotene and bromegrass the least during the spring. The reverse was true during the summer.

There were no great differences among the forages in hydrogen-ion concentration (pH) of the cell sap or in the percentage of total available carbohydrates (total available corbohydrates of bromegrass and the alfalfa-bromegrass mixture were not determined) at the different stages of growth or during the two growing periods.

There was a significant negative correlation between the percentages of protein and fiber for all forages at all growth periods. Usually, there was a negative and significant correlation of fiber percentage with ash, P, K, and carotene contents. Correlations of fiber with either NFE or Ca were generally non-significant during both growth periods.

Correlation between the percentages of ash and Ca was generally non-significant while the correlation of ash, with P was generally significant and positive at all growth periods for all forages, except for bromegrass-alone. There was no clear indication of a correlation between ash and K.

A significant positive correlation was found between the percentages of protein and P and between protein and K at all growth periods for each forage and over all forages, except for ladino clover.

There was usually a significant positive association of the p.p.m. of carotene with the percentages of both P and K, and between P and K, for all comparisons. However, no relationship existed generally between Ca and either P or K for the individual forages.

The relationship between the percentage of protein and p.p.m. of carotene was generally significant and positive for all growth periods and for all forages, except for ladino clover. Carotene was not associated with protein at any period in ladino clover.

The percentages of protein, P, and K, and the p.p.m. of carotene of the alfalfa-bromegrass mixture during the fall growth period decreased with advance in maturity as it did during the spring and summer. However, the percentage of fiber did not increase, nor did the percentage of ash decrease, with advance in maturity in the fall growth as occurred during the spring and summer.

The alfalfa-bromegrass mixture increased markedly in the percentage of Ca with advance in maturity during the fall but there was no definite change during the spring or summer. The percentages of protein, fat, NFE, and Ca were usually higher, and the percentages of fiber, P, and K were usually lower, during the fall than during the spring or summer at comparable stages of growth.

The most favorable time to harvest all of the species in order to obtain an optimum yield of desirable nutrients and a minimum yield of undesirable nutrients, under the conditions of this study, generally occurred when alfalfa approached the 1/10 bloom stage of growth during both the spring and summer periods.

Agr. Expt. Sta., U. Wisc., Madison, Wisc.

Dye, W. B., and O'Harra, J. L. MOLYBDENOSIS. Nev. Agr. Expt. Sta. B. 208, 32 pp. 1960.

A map is presented showing the known molybdenum toxicity areas in Nevada and California. Symptoms of molybdenosis or "alkalied cattle" are scouring, unthriftiness, rough hair coat, hair color change (red to straw color, and black to mouse gray), dehydration, arching of the back, listlessness and weakness, brittle bones, emaciation, and in more extreme cases, death.

Diagnosis of molybdenosis is made on the basis of symptoms, history of the feed or area, chemical analysis of the forage for molybdenum and copper, and response to copper therapy.

Treatment of molybdenosis falls in three general types: (1) Oral ingestion of copper sulfate in feed, water, or salt. One gram of copper sulfate ($CuSO_4 \cdot 5H_2O$) per head per day. It may be administered in water, salt, or pellets. (2) Treatment of soil. And (3) injection of copper glycinate suspension (one cc. of copper glycinate suspension injected subcutaneously into young calves; two cc. for older cattle).

A Copper-Molybdenum (Cu-Mo) experiment using two molybdenum-poisoned heifers, 295 pounds each, starting weights, was set up. "Kupfer," was injected with copper glycinate, the other heifer, "Moly," was left untreated. Both animals were placed in the same pen, drank the same water, and ate the same alfalfa-timothy hay that contained 12-15 p.p.m. Mo and 21 percent protein.

At the end of 231 days, "Kupfer" weighed 695 pounds and "Moly" 310 pounds. "Moly" was then injected with copper glycinate, 96 days later "Kupfer" weighed 845 pounds, "Moly" 510 pounds. Conclusions are--if cattle are injected with copper glycinate, they can eat high Mo hay and make good weight gains for more than 8 months.

In 1958 more than 26 ranches in Nevada, involving 3,700-4,000 head of cattle, participated in field trials. All results were favorable and 24 of 26 ranches asked to have their cattle injected with copper glycinate again in 1959. The results showed that: (1) If animals were on pasture, the injection was effective for at least three months for young calves and six months for older cattle. (2) The rate of gain for the treated over the untreated animals ranged from 3-48 pounds per month per head. All treated animals looked sleek and thrifty. (3) Younger cattle gained faster than older cattle. (4) If the cattle ate "copperized salt" well, either method of protection was equally good. (5) Sub-cutaneous injections, preferably in the brisket area, may produce lumps, but these disappear in a few weeks. Even the few (12 or so) sterile abcesses noted in the 3,700-4,000 head were not serious. No injected cattle were lost during the field trials. (6) The rate of gain of the injected cattle was not affected by high Mo (at least up to 34 p.p.m. Mo on pasture); but it depended on the quality of the feed. And (7) copper glycinate injections make it feasible for ranchers in high Mo areas to induce the growth of high protein legumes in their meadows and pastures.

Agr. Expt. Sta., Mac C. Fleischmann Col. Agr., U. Nev., Reno, Nevada

Radioactive Fallout

Menzel, R. G. TRANSPORT OF STRONTIUM-90 IN RUNOFF. Sci. 131(3399): 499-500. Feb. 1960.

Strontium-90 is deposited on soil surfaces chiefly through rainfall. Thus it would seem to be especially likely to move in surface runoff. The extent of this movement was measured on plots which had previously been established for the study of soil losses by rainfall erosion.

Only a small portion of the strontium-90 that fell on cultivated soils was removed in runoff. The concentration of strontium-90 was usually about 10 times higher in the soil carried by the runoff than in the soil from the plow layer of the plots. Thus, a considerable concentration of Sr^{90} could occur in areas where runoff sediments accumulate.

SWCRD, ARS, USDA, Beltsville, Md.

Schulz, R. K., Overstreet, R., and Barshad, I. ON THE SOIL CHEMISTRY OF CESIUM 137. Soil Sci. 89: 16-27. 1960.

The nonexchangeable fixation of macro amounts of cesium in the five soils investigated appears to be different in character from the corresponding fixation of potassium and ammonium. In addition, of the five minerals studied, only vermiculite could account for the magnitude of the fixation encountered in soils such as Vina, Yorkville, and Yolo, and for the behavior of the soils towards extraction with Cs+ and Ca++.

It is further concluded that the fixation of Cs 137 in soils in carrier-free amounts is an essentially different process from those predominant in the fixation of macro amounts of cesium, potassium, and ammonium. Moreover, only in the minerals illite and chlorite is Cs 137 extractable by ions in a fashion similar to that observed in the soils.

On the basis of the data presented, the authors are inclined to believe that carrier-free cesium may be fixed in soils by way of a precipitation of the element on surfaces of micaceous minerals. That is, in the precipitation the existing crystal lattice is altered or extended slightly so that the cesium is incorporated in a crystal structure. Also, even though this structure is continually dissolving and reforming, microscopically, the cesium cannot be released by exchange for H+, Na+, Ca++, Mg++, or Ba++, because these ions do not fit into the crystal lattice. On the other hand, because of the microscopic dissolving and reforming, cesium is released to some extent by K+, NH_4+, and Cs+, since such ions can substitute for cesium in the crystal.

U. Calif., Berkeley, Calif.

SOIL SURVEYS

Genesis and Morphology

Carson, C. E., and Hussey, K. M. THE MULTIPLE-WORKING HYPOTHESIS AS APPLIED TO ALASKA'S ORIENTED LAKES. Iowa Acad. Sci. Proc. 66: 334-349. 1959.

The problem of the oriented lakes on Alaska's Arctic Coastal Plain provides an excellent opportunity for illustrating the application of the method of multiple-working hypotheses to a geologic problem. Five hypotheses are considered and are deemed to be inconclusive; a composite of these is thought to provide an explanation of the lakes' origin. The hypotheses considered are: (1) That waves, produced by an ancient prevailing wind blowing parallel to the lake elongation, eroded the basins; (2) that the present winds produce wave current systems which preferentially scour the north and south lake shores, thus producing elongation; (3) that the winds produce a preferred distribution of sediment which determines orientation of the lakes by insulating the east and west shores, thus protecting them from erosion; (4) that orientation is developed by thaw produced by maximum insolation during the noon-hours; and (5) that the lakes are developed along north-south trending ice-wedges which formed in the north-south components of a right-angle fracture system. The process of consideration and elimination of these hypotheses leads to a composite hypothesis. This proposes that oriented ice-wedges might develop in the fracture system; that maximum insolation would be more effective in melting the north-south trending wedges that the complementary set; that the oriented depressions so oriented would in effect be perpetuated and enlarged by thaw and wind (wave) oriented sediments on the east-west shores.

Iowa State U., Ames, Iowa.

Ulrich, R., Arkley, R. J., Nelson, R. E., and Wagner, R. J. CHARACTERISTICS AND GENESIS OF SOME SOILS OF SAN MATEO COUNTY, CALIFORNIA. Soil Sci. 88: 218-227. 1959.

Five representative soils of the cool, foggy coastal areas of central California are described on the basis of field observations and physical, chemical, and clay mineral analyses. Parent materials and time are the principal factors responsible for differences in soils of the lower-lying coastal terraces--the Elkhorn, Denison, and Tierra soil series. These soils reflect moderate to strong textural B_2 development, and cyclic salt has been a factor in their development. Because of the usual combinations of soil-forming factors, these soils exhibit many inter-grading characteristics in terms of recognized great soil groups: Elkhorn variant--sol lessive, intergrade to prairie; Denison--medial prairie, intergrade to grumusol and solonetz; Tierra--plansol, intergrade to solonetz. Parent materials and vegetation are the key factors responsible for differences in soils of the upland areas having somewhat less fog and little cyclic salt influence in soil development. The basic parent materials of the Sweeney soils decompose rapidly to secondary clay-size minerals, whereas the Hugo soils derived from sandstone under forest have little evidence of clay formation and the soils have minimal development. The Sweeney is classified as a minimal prairie and the Hugo as a sol brun acide.

SCS, USDA, Berkeley, Calif.

Ivanova, Y. N., Lobova, Y. V., and Rozanov, A. N. REVIEW OF PAPERS ON SOIL GENESIS IN VOL. V OF THE PROCEEDINGS OF THE SIXTH INTERNATIONAL CONGRESS OF SOIL SCIENCE. Soviet Soil Sci. 5: 521-531. May 1958.

Great attention was given to soil genesis at the Sixth International Congress of Soil Science held in Paris in 1956. Most of those reporting to the Fifth Commission discussed this question at least to some extent. This article is a review of the reports presented by foreign scientists on the subject of tropical, subtropical, and temperate regions.

Amer. Inst. Biol. Sci., 2000 P St. N.W., Washington 6, D.C.

Wright, J. R., Leahey, A., and Rice, H. M. CHEMICAL, MORPHOLOGICAL AND MINERALOGICAL CHARACTERISTICS OF A CHRONOSEQUENCE OF SOILS ON ALLUVIAL DEPOSITS IN THE NORTHWEST TERRITORIES. Canad. J. Soil Sci. 39: 32-43. 1960.

The Grey Wooded soil zone in Canada occupies the forested parts of the Great Plains region in Western Canada as far north as Fort Simpson, Northwest Territories. In the northwestern part of this soil zone three distinct profile types of soil are often found on alluvial deposits. These profile types have been classified as belonging to the Alluvial, the Brown Wooded, and the Grey Wooded groups. Usually the Alluvial soil occupies the lowest terrace, the Brown Wooded the middle terraces, and the Grey Wooded the highest terraces above the river. Since the occurrence of these profile types is directly related to their height above the river it would appear that they represent a chronosequence in soil formation.

The chemical, morphological, and mineralogical characteristics of these soils are given and soil development is discussed.

The present studies indicate that the pattern of development in the formation of these soils on calcareous alluvial materials in Northwestern Canada is as follows: (1) Accumulation of organic matter in the upper part of the calcareous soil-forming materials; (2) decomposition of carbonates, with calcium being removed about twice as rapidly as magnesium, followed by the depletion of organic matter; (3) greater loss of silica than sesquioxides in the earlier stages of development probably during depletion of carbonates; (4) continued loss of bases, particularly calcium, subsequent to depletion of carbonates accompanied by a further decrease in pH and further loss of organic matter; and (5) marked eluviation of clay and accelerated leaching of iron and aluminum with respect to silica resulting in a distinct siliceous eluviated layer (A_2) underlain by a clay- and sesquioxide-enriched layer (B).

Expt. Farm Serv., Canada Dept. Agr., Ottawa, Ontario, Canada.

DeKoster, G. R., Hussey, K. M., and Munson, R. D. THE VARIED CHARACTER OF THE DES MOINES RIVER VALLEY IN CENTRAL IOWA. Iowa Acad. Sci. Proc. 66: 312-316. 1959.

The drainage system on the Des Moines River is quite varied between Humboldt and Des Moines. The variation in drainage characters is highlighted on a map prepared from aerial photographs and topographic sheets. The northern part of this area is associated with the Mankato drift sheet and is characterized by poorly developed, non-integrated drainage. The central part of the drainage system in Boone County flows across the Cary ground moraine. In this area the tributaries are short, intermittent, and deep, and appear as gullies and washes. Just south of Des Moines, the drainage makes another sharp change, and in this area is associated with the Kansan drift. It is well integrated and featured by a relatively small number of far-reaching primary tributaries. It seems to be more than coincidental that the change in character of the drainage is so closely associated with the relative ages of the drift sheets comprising the drift plain.

Iowa State U., Ames, Iowa.

Verigina, K. V. CHARACTERISTICS OF SOIL FORMATION UNDER FOREST AND PLOWED LAND IN KALININGRAD REGION. Soviet Soil Sci. 5: 488-496. May 1958.

The object of the present work is the characterization of the various processes of soil formation in both forest and cultivated sod-podzolic soils. This report is on the same soils of the Kaliningrad region under spruce forest and cultivated land.

The following conclusions were reached:

1. Cultivated sod-podzolic soils differ from forest sod-podzolic soils in less differentiation of soil profile by morphological features, and homogeneity of the plow layer of the profile in both total composition and texture.
2. Soil solutions of cultivated and forest soils differ in composition and degree of mineralization.
3. Forest soil solutions were characterized by considerable difference in composition along the profile and by comparatively small variability during the period of observation. The composition of cultivated soil solutions is more homogeneous in the upper part of the soil profile but varies more with time.
4. Organic matter was the main component of the soil solutions of forest litter and the accumulative horizon of forest soil during the entire period of observation. In soil solutions from the upper horizons of forest soil, organic matter predominates over mineral residue. The content of organic matter in cultivated soil solutions is lower than in those from forest soil, and the mineral residue in the cultivated soil solutions predominates over organic matter.
5. The degree of mineralization of cultivated soil solutions is especially high in spring, as a consequence of the high rate of nitrification and the accumulation in the soil solutions of calcium nitrate. Nitrates are not found in the forest soil solutions.
6. The soil solutions from accumulative horizons of forest soil, in spite of their high biological accumulation of calcium, like the soil solutions from the podzolized horizons of this soil, have an acid reaction which is caused by the presence of organic acids. The reaction of the soil solution from the plow and subsoil horizons of cultivated soil approaches neutrality. The reaction of soil solutions changed insignificantly during the period of observation.
7. In both forest and cultivated soil solutions no phosphoric acid was found.
8. The constant presence in forest soil solutions of divalent iron is an important distinguishing sign formation under a forest. In soil solutions of cultivated soils, divalent iron is absent.

Amer. Inst. Biol. Sci., 2000 P St. N.W., Washington 6, D.C.

Hutchieson, T. B., Jr., Lewis, R. J., and Seay, W. A. CHEMICAL AND CLAY MINERALOGICAL PROPERTIES OF CERTAIN MEMPHIS CATENA SOILS OF WESTERN KENTUCKY. Soil Sci. Soc. Amer. Proc. 23: 474-478. 1959.

Chemical and clay mineralogical properties of Memphis, Grenada, Calloway, and Henry series were determined and related to degree of internal drainage and genesis. Percent base saturation and other chemical data indicated that the more poorly drained profiles were more severely leached than better drained members. These data, together with the occurrence of larger proportions of expanding lattice 2:1 type minerals to non-expanding 2:1 types in the more poorly drained profiles, suggest that a high degree of weathering was attained before pan horizon formation occurred.

The presence of lower exchangeable Ca/Mg + Na ratios along with lower montmorillonite/vermiculite ratios in B_{3m} horizons than in deeper or shallower horizons suggests that the pans are the result of packing of dispersed clay particles and that vermiculite has formed from montmorillonite or other weathering products in those horizons.

Ky. Agr. Expt. Sta., Lexington, Ky.

Whittig, L. D. CHARACTERISTICS AND GENESIS OF A SOLODIZED-SOLONETZ OF CALIFORNIA. Soil Sci. Soc. Amer. Proc. 23: 469-473. 1959.

Field and laboratory studies of a soil (Solano series) of the lower Sacramento Valley characterize it as a solodized-solonetz. The profile has a sharply delineated, alkaline, fine-textured, columnar B horizon below an acid, medium-textured A horizon. Remnants of an older columnar B horizon persist in the present upper leached portion of the soil.

Soluble salts and free carbonates and much of the clay have been leached from the upper 15 inches of the profile, but are present in appreciable concentrations below this level. Na is the predominant soluble cation. Of the exchangeable bases, Mg is dominant throughout the profile, increasing markedly with depth. Exchangeable Na is low near the surface and increases with depth at a slightly faster rate than does Mg.

Montmorillonite is the predominant mineral of the clay fraction throughout the profile. Kaolin and a small amount of illite are also present throughout. Vermiculite and chlorite, as constituents of the coarse clay fraction (2 to 0.2/μ), are concentrated in the A horizons of the profile.

It is concluded that the soil has been altered by solidization as indicated by the sharp boundary between the leached, acid A horizons and the alkaline, fine-textured B horizon containing soluble salts. In its evolutionary past, this soil has been strongly affected by Na and other soluble salts as indicated by the occurrence of older column tops in the present A horizon, distribution of soluble and exchangeable cations and clay, and the distinctive morphology of the profile. At times, salinization, solonization, and solodization have all affected development of this soil. It is doubtful, however, whether it will develop eventually into a true solodi because of the presence of an abundant supply of divalent cations which are being returned annually to the surface by selective plant feeding.

U. Calif., Davis, Calif.

Fanning, C. D., and Gray, F. CHARACTERIZATION AND GENETIC STUDY OF A DENNIS AND A PARSONS SOIL. Soil Sci. Soc. Amer. Proc. 23: 321-324. 1959.

The Dennis series is comprised of deep, well-drained Prairie soils developed in slightly acid to neutral, silty, and clayey shales of the Pennsylvanian Age. Dennis develops in materials of intermediate texture on gently sloping, erosional uplands, whereas Parsons, a Prairie Planosol, develops in more clayey beds on gentle slopes and flats. They occur naturally associated and extensively in Oklahoma, Kansas, and Missouri.

A modal profile of each series was sampled in detail. Morphological, chemical, physical, and clay mineralogical studies were made on each subhorizon. The clay was separated into two fractions: 2 to 0.1/μ (coarse clay) and $< 0.1/\mu$ (fine clay). Analyses were made for ethylene glycol retention, nonexchangeable K, cation exchange capacity, differential thermal, and X-ray diffraction. Computations were made for clay mineral composition.

Results show several times as much fine clay as coarse clay. In the Dennis the maximum clay accumulation occurs from 26 to 31 inches and in the Parsons from 22 to 28 inches. In the Dennis, coarse clay gradually decreases with horizonation and weathering, whereas in Parsons, it accumulates. Montmorillonitic-type minerals dominate the fine clays of both profiles while kaolinitic and illitic types are dominant in the coarse clays.

Okla. State U., Stillwater, Okla.

Sandoval, F. M., Jr., Frosberg, M. A., and Lewis, G. C. A CHARACTERIZATION OF THE SEBREE-CHILCOTT SOIL SERIES ASSOCIATION (SLICK SPOTS) IN IDAHO. Soil Sci. Soc. Amer. Proc. 23: 317-321. 1959.

A study was made of the Sebree-Chilcott soil series association of south-western Idaho with respect to morphology, physiography, and physical and chemical properties.

Parent materials are of fluviatile and lacustrine origin occurring on terraces of different geologic age. The Sebree soil (slick spots) is relatively impermeable with little or no vegetation. Diameter of the spots vary from a few inches to 50 feet or more, with irregular shapes.

The soils studied exhibit solodized characteristics with textural and color B horizons of solonetz morphology overlying prominent $CaCO_3$ accumulations. Degree of cementation of the calcareous layers appears to be related to geologic age. The surface has a silt loam texture.

Slick spot soils have a very thin A_2 horizon overlying thicker B_2 layers characterized by high exchangeable Na and in most cases high concentration of soluble salts. Ions that predominate are $Na+$, SO_4--and Cl-. Gypsum is present in the lower B_2 and B_3 horizons. Horizons of prominent lime accumulation have a bowl-shaped form under the slick spot. The data indicate that slick spots represented retarded soil-forming processes which have somehow resisted the efforts of nature in their normal development.

Res. Paper 449, Idaho Agr. Expt. Sta., U. Idaho, Moscow, Idaho.

Hidlebaugh, A. R. VARIATIONS IN MANKATO GLACIAL TILL AND RELATED SOIL TYPES IN HAMILTON COUNTY, IOWA. Iowa Acad. Sci. Proc. 66: 272-279. 1959.

Soil surveys in Hamilton County, Iowa, have shown a need for the revision of the Clarion and Nicollet soil series to include the fine textured variant soils found there or for the establishment of new series. The results of this study show that sufficient differences exist to warrant the establishment of new series for the fine textured variants of Clarion and Nicollet. They are higher in clay content, have lower chroma in the A horizon, have higher gravel content, have higher bulk density, are firmer in consistence, have finer and better developed structure, and mottling occurs at shallower depths, than the normal Clarion and Nicollet soils.

SCS, USDA and J. Paper 3638, Iowa Agr. Expt. Sta., Ames, Iowa

Arneman, H. F., and Wright, H. E., Jr. PETROGRAPHY OF SOME MINNESOTA TILLS. J. Sedimentary Petrology 29: 540-554. 1959.

Wisconsin tills in Minnesota may be assigned to different ice lobes depending primarily upon the color, texture, stone content, and other petrographic characteristics. These petrographic features have their origin chiefly in distinctive types of bedrock in Minnesota and adjacent areas. The Precambrian rocks that underlie the drift over most of the state include red sandstone and slate in a belt extending south-southwest from the head of Lake Superior; basalt, felsite, gabbro, anorthosite, and related rocks in the highland north of Lake Superior, iron formation; and various metamorphic and granitic rocks. Paleozoic carbonate rocks are found principally in southern Manitoba but also in southeastern Minnesota. Cretaceous shale occurs in the area of the Red River Valley and in southwestern Minnesota.

The configuration of the several ice lobes was determined partly by the presence of lowlands in the bedrock, notably one following the Red River-Minnesota River valleys (Des Moines lobe) and one following a lowland extension of the Lake Superior basin (Superior lobe). The central part of the state was occupied by the Wadena lobe and the Rainy lobe, and their directions of movement were probably controlled by mutual interference as well as by pre-existing topography.

The Wisconsin glacial history in Minnesota was marked also by repeated advances of the several ice lobes. In this case of the Superior lobe the tills assigned to the Cary and Valders advances may be identified texturally because the Valders till was formed by the incorporation of lake clays deposited in the Lake Superior basin during the Two Creeks interstadial just preceding, where the Cary Superior till is sandy. A Mankato Superior till identified on morphologic grounds, appears to have an intermediate (silty) texture.

Of the two tills of western source, the Wadena is the more sandy, probably because the Des Moines till passed over Cretaceous shale. The tills of the Rainy lobe and its two sublobes (Pierz and Brainerd) are all sandy and are stonier than the tills of the other lobes.

Stone counts are perhaps the most diagnostic petrographic characteristic of Minnesota tills. They are easily made and generally point to the correct assignment. Difficulties occur where tills contaminate one another in contact zones. Color distinctions, as measured by the Munsell color chart or in the laboratory by the Clark-Maxwell method, are also generally distinct.

Heavy-mineral analyses and clay-mineral analyses are of limited use in differentiating tills. They are time-consuming and not particularly diagnostic.

U. Minn., Minneapolis, Minn.

Coogan, A. H., and Irving, W. N. LATE PLEISTOCENE AND RECENT MISSOURI RIVER TERRACES IN THE BIG BEND RESERVOIR, SOUTH DAKOTA. Iowa Acad. Sci. Proc. 66: 317-327. 1959.

Three cut-and-fill terraces of the Missouri River are present in the Big Bend Reservoir. The upper terrace (Mt-2), tentatively correlated with the Cary moraine, consists of outwash sands and gravels. It stands at heights of 80-100 feet above the river. Its surface is capped by a deposit of as much as 30 feet of aeolian sand and silt. The intermediate terrace (Mt-1) consists of gravel, sand, and silt, and stands at heights of 35-45 feet above the river. It, too, is capped with aeolian sand and silt. This terrace is tentatively dated as Mankato, but may be younger. The lower terrace (Mt-0) stands 10-15 feet above the average river level and is the flood plain of the present Missouri River. The upper part of the terrace fill consists of sand and silt of Recent age. The lower part of the fill is gravel, sand, and silt and is probably post-Altithermal but may be late Pleistocene in age. Several humic horizons are present in the silt covering both Mt-1 and Mt-2, and a well-defined paleosol is buried in the silt on Mt-2. Study of these horizons indicates the possibilities of correlating them with geological events and of finding a stratigraphic separation of archeological remains dating from Pleistocene to late prehistoric times.

Cornell Col., Mount Vernon, Iowa.

Theisen, A. A., and Knox, E. G. DISTRIBUTION AND CHARACTERISTICS OF LOESSIAL SOIL PARENT MATERIAL IN NORTHWESTERN OREGON. Soil Sci. Soc. Amer. Proc. 23: 385-388. 1959.

Field study, mechanical analysis, and X-ray diffraction analysis (of fine silt) were used to identify as loess a silty deposit bordering the Columbia River near Portland, Oregon. The loess material is 65 to 75% silt and pale brown. It commonly overlies reddish brown clay derived from Columbia River basalt. Quartz and feldspars were found in fine silt of the loess. Only quartz was positively identified in fine silt of the underlying material from basalt. Thinning with distance from the Columbia River and also from a point north of Portland indicates that the loess source was a former Columbia River floodplain, particularly the wide area north of Portland. Vertical discontinuities in particle size distribution and mineralogy, not coinciding with genetic horizons, suggested the existence of more than one period of loess deposition.

Oreg. Agr. Expt. Sta., Corvallis, Oreg.

Vaychis, M. V. INFLUENCE OF EUROPEAN LARCH ON CHANGES IN SOD-PODZOLIC SOILS. Soviet Soil Sci. 5: 480-487. May 1958.

The influence of the larch on soil change is not clear and has not been adequately investigated. Studies conducted in this direction are of considerable scientific and practical importance because the larch is invading more and more into the forests of the European part of the USSR.

Investigations were conducted in the Lithuanian SSR where considerable attention is given to growing larch. For comparison, the influence of the larch on soil changes was studied in pairs of larch and spruce plantations of approximately the same age and site quality growing in Sod-podzolic soils of various textures.

The authors conclude that:

1. The distinctly positive influence of the European larch on sod-podzolic soil began to appear with 20 year old plantations.
2. It was manifested by an intensified circulation of ash substances between the leaf-fall and litter and the soils, inasmuch as decomposition of the litter of the European larch proceeded more actively than that of the spruce.
3. The ash elements, especially Ca and Mg, set free by the decomposition of organic substances, were fixed to the adsorbing complex of the soil, which caused the sharp rise in their saturation and the lowering of the acidity.
4. Because the larch roots penetrated deeper into the soil than those of the spruce, the permeability of soil under larch was improved, and made possible both greater mobilization of Ca from the litters of morainic carbonate clay loams or clays and also neutralization of the organic acids formed during decomposition of the litter.
5. The circulation of matter in the soils under spruce was limited to a depth of 50 to 60 cm. (20-24in.), and the ash substances were subjected to considerably greater leaching and saturation by hydrogen and aluminum. Consequently, podzolization was intensified and there was a secondary biological accumulation of $Si0_2$.
6. Under larch plantations horizon A_2, owing to a greater secondary saturation, lost the characteristics and properties typical of podzolic soils.
7. The observed changes in the coarse-textured sod-podzolic soils which developed on the finer morainic carbonate clay loams allow us to conclude that under the influence of larch these soils evolved toward brown forest soils.
8. As a result of the change in properties of the sod-podzolic soils under larch plantations, their soil fertility also improved, assuring the growth of plantings of site quality class I and Ia.

Amer. Inst. Biol. Sci., 2000 P St. N.W., Washington 6, D.C.

Jarvis, N. L., Ellis, R., Jr., and Bidwell, O. W. A CHEMICAL AND MINERALOGICAL CHARACTERIZATION OF SELECTED BRUNIZEM, REDDISH PRAIRIE, GRUMUSOL, AND PLANOSOL SOILS DEVELOPED IN PRE-PLEISTOCENE MATERIALS. Soil Sci. Soc. Amer. Proc. 23: 234-239. 1959.

A study was made of the role parent materials have played in determining the physical and chemical properties of four soil series of southeastern Kansas. The soils of this region are dominantly Brunizems; but Planosols, Grumusols, and Reddish Prairie soils also occur. These soils have developed in residuum and colluvium of sandstone, limestone, and shales. The soil series studied were the Taloka, Newtonia, Bates, and Summit--each sampled and studied in duplicate. The physical and chemical properties investigated were clay mineral composition, exchange capacity, total exchangeable cations, pH, percent organic matter, and particle size analysis.

Qualitative and semiquantitative estimations were made of the minerals occurring in the clay fractions of the soils and underlying parent materials. The predominant clay mineral in the Taloka, Newtonia, and Bates soils is montmorillonitic, whereas interstratified illitic and montmorillonitic clays are predominant in the Summit soils. Smaller amounts of quartz, illitic, kaolinitic, and vermiculite minerals are present in many of the clay fractions of the soils. The clay mineral contents of the developed soil profiles and their underlying parent materials were compared to determine the extent to which the clay minerals in the soil have been altered by weathering. Technical profile descriptions of the soils are presented.

Kans. Agr. Expt. Sta., Manhattan, Kans.

Lag, J. OBSERVATIONS ON SPECIAL COLORS OF THE A_2-LAYER OF PODZOL SOILS IN NORWAY. Acta Agr. Scandinavia 10(1): 45-49. 1960.

The color of the A_2-layer of the podzol soils may be expected to vary with: (1) the intermixture of humus, and (2) the degree of weathering of the mineral material. In areas recently glaciated, as in the countries of Northern Europe, decomposition will be relatively small, and the mineral material's own color may here make itself felt in the A_2-layer.

A description is given of podzol soils in nordmarkite-ekerite morainic material in the Oslo region, whose A_2-layer was of pink color.

Profiles in which the A_2-layer is darker than the B-layer occur in material of shale and phyllite. Podzol profiles with very dark gray A_2-layer have been found on the mountain plateau Hardangervidda, in soil material of phyllite. In some cases this layer had, in wet condition, to be characterized as black, according to Munsell color chart. The B-layer was of a yellowish red, brown, or strong brown color.

Agr. Col., Norway, Vollebekk, Norway.

Buol, S. W., and Hole, F. D. SOME CHARACTERISTICS OF CLAY SKINS ON PEDS IN THE B HORIZON OF A GRAY-BROWN PODZOLIC SOIL. Soil Sci. Soc. Amer. Proc. 23: 239-241. 1959.

Clay coatings or skins were removed from peds in the B_3 horizon of a Gray-Brown Podzolic soil, Ockley sil of southern Wisconsin. Analyses were made to determine the contents, both in the clay skins and in the entire horizon, of N, C, clay, reductant-soluble Fe, total Fe, Al, Na, K, Ca, Si, Mg, and Ti. Thin sections were made of peds from the B_3 horizon and were examined with the aid of a petrographic microscope to determine the structure of the clay skins.

The results of analyses for the clay skins show relatively high contents of N(0.11%), C (1.836%), clay (87.4%), free Fe (2.76%), as compared with contents in the bulk sample from the B_3 horizon: 0.029% N, 0.417% C, 24.3% clay, and 1.33% free Fe. X-ray diffraction patterns showed that the clay in the bulk sample contained slightly more chlorite and slightly less vermiculite and chlorite-vermiculite intergrade than the clay of the clay skin. Microscopic thin-sections of clay skins showed a mean clay-skin thickness of 0.079 mm., with component lamellae each 0.007 to 0.010 mm. thick.

The author makes the following conclusions: (1) Clay skins have been observed in many different soils. It may be assumed, therefore, that they are formed by a condition or set of conditions common to many parts of the world. (2) The data presented clearly show that the clay-skin material in the lower B horizon of a Gray-Brown Podzolic soil in Wisconsin is quite different in several respects from the rest of the soil material in that horizon. And (3) clay skins were found around roots in the horizon examined. This suggests that clay skins, regardless of how they have been formed, may have considerable influence on the growth of plants in this and similar soils.

U. Wisc., Madison, Wisc.

Dmitriyeva, N. V. THE BROWN FOREST SOILS OF THE KODRY. Soviet Soil Sci. 7: 792-799. July 1958.

The great soil group of the brown forest soils ("brown earths") has been considered as characteristic of Central Europe. It is generally recognized that brown forest soils are a zonal type; their areal distribution corresponds to that of brown-leaved forests in regions with a moderately moist and warm climate. These soils are widespread in Germany, Poland, Bulgaria, Hungary, and Rumania. In the USSR they are located in the Crimea, the Caucasus, the mountainous regions of Central Asia, in the Far East and in the Transcarpathia.

In a study of the brown forest soils of the Kodry in Russia the following conclusions were reached: (1) A typical characteristic of brown forest soils of the Kodry, as of all brown forest soils in warm, moist climates in piedmont or plains regions, is their considerable thickness. Here, the stratum of parent material involved in soil formation is always considerably greater when brown forest soils are formed than when gray forest soils are formed, probably because of the greater age of the former. (2) One of the basic genetic characteristics of brown forest soils is simultaneous combination in them of two opposing processes: podzolization, with eluviation of alkaline earth metals and sesquioxides on the one hand, and the energetic formation of clay, with the accumulation of these substances as secondary minerals. The predominance of clay formation over podzolization is a specific characteristic of these soils. Energetic clay formation takes place both because of weathering within the soil and also as a result of biological processes. (3) Formation of the illuvial horizon in podzolized brown forest soils takes place principally at the expense of iron. Aluminum has proved to be less mobile and accumulates in the upper part of the profile. And (4) the energetic formation of clay in the profile and the high degree of biological accumulation of adsorbed cations cause one more specific characteristic of brown forest soils: the high extent of saturation with cations.

Amer. Inst. Biol. Sci., 2000 P St., N.W., Washington 6, D.C.

England, C. B., and Perkins, H. F. CHARACTERISTICS OF THREE REDDISH BROWN LATERITIC SOILS OF GEORGIA. Soil Sci. 88: 294-302. 1959.

Profile characteristics and chemical and clay mineral properties were determined for the Davidson, Greenville, and Decatur soil series, which represent important reddish-brown lateritic soils of Georgia.

The soils are characterized by deep profiles of reddish-brown color and high clay content. They are very similar in chemical properties, being highly weathered and leached. Kaolinite is the predominant mineral in the collodial fractions. Vermiculite occurs in secondary amounts, and smaller quantities of other minerals are frequently present.

The lack of morphological A_2 horizon distinguishes these from the associated red-yellow podzolic soils. Laboratory determinations of cation-exchange capacity, total carbon, and free Fe suggest the presence of a weakly developed A_2 horizon. This evidence indicates mild podzolization of this group of soils and illustrates their intergradation toward the red-yellow podzolic group.

U. Ga., Col. Expt. Sta., Athens, Ga.

Classification and Land Use

Germasimov, I. P., and Ivanova, Y. N. COMPARISON OF THREE SCIENTIFIC TRENDS IN RESOLVING GENERAL QUESTIONS OF SOIL CLASSIFICATION. Soviet Soil Sci. 11: 1190-1205. Nov. 1958.

Soil literature of the world today contains a vast amount of material on soil classification which is extremely diversified in subject matter, scientific principles, and proposed theories. Consequently, a thorough and detailed systematization of such data is imperative for an objective analysis aimed at establishing points of similarity among different scientific trends in soil classification and nomenclature in various countries. Inadequate mutual understanding in this field of science considerably hinders the proper application and generalization of scientific soil data on a universal scale, and constitutes an obstacle to the full realization of an international community of soil scientists and to the exchange of their theoretical concepts and practical experience.

This article attempts to examine, in brief, the theory behind and the interrelationship of the Soviet (Russian), Weatern European, and American trends in resolving soil classification questions. Although not representing all of the existing schools of thought in soil science, these three trends are the most prevalent.

Amer. Inst. Biol. Sci., 2000 P St. N.W., Washington 6, D.C.

Ivanova, Y. N., and Rozov, N. N. THE STATUS AND DEVELOPMENT OF CLASSIFICATION PROBLEMS IN SOIL SCIENCE. Soviet Soil Sci. 10: 1127-1134. Oct. 1958.

The three main schools in the development of the classification problem in world soil science are Soviet, Western European, and American. The schools differ in respect to their methods of morphological-physicchemical study of soils and in the depth and breadth of their genetic approach to the problem. Inasmuch as the task of establishing a unified world soil classification is a matter of the greatest importance, a deep scientific analysis of these schools and their gradual unification are becoming inevitable.

The Soviet school is based on the simultaneous study of soil properties and processes of soil formation, and uses Dokuchayev's method of comparative geographical analysis. This approach makes broad genetic generalizations possible when solving the classification problem as a whole. It also permits an understanding of the genesis of individual groups, subgroup, genera, and species of soils.

The Western European school as shown by the papers and reports presented at the Sixth International Soil Congress and other published works engages in a profound study of individual soil properties and the genesis of individual soil groups. Problems of soil evolution are usually regarded from a single aspect (chiefly from the parent material to the soil or from a hydromorphous soil to an automorphous soil) independently of the overall evolution of zonal landscapes.

The American school has its own peculiarities in dealing with soil classification. It is characterized by a long-existing break between the "great soil groups," genetic in nature, and chemical-morphological series and American soil types.

These special characteristics, however, do not exhaust the peculiarities of each of these schools.

This article gives a review of foreign (to Russia) work on soil classification.

Amer. Inst. Biol. Sci., 2000 P St. N.W., Washington 6, D.C.

Adams, H. R. LAND-USE IN NEW HAMPSHIRE--AS AFFECTED BY SOIL AND SLOPE CONDITIONS. J. Soil and Water Conserv. 15: 24-27. 1960.

An analysis of soil survey data from about one and a fourth million acres of land in all counties in New Hampshire shows some interesting relations between land use and various soil and slope conditions. The present distribution of land use is the result of a process of selection that has been going on during the 300 years since white men settled in the state. A study of the data shows the nature of the land that farmers have decided is best suited to cropping. It also shows that some conditions that may be highly important in governing land use in other parts of the country have less effect on such use in New Hampshire.

In the area studied, the present land use at the time of survey was distributed about as follows: woodland 76%, cropland 12%, pasture 7%, idle land 4%, and urban and residential areas 1%.

A study of soil survey data from about one-fifth of the acreage in New Hampshire shows that about two-thirds of the area is too stony for cultivation. Very little of the non-stony soil is on slopes steeper than 25 percent. Steepness of slope and soil-moisture relations have had a major influence in the use of stone-free soils, and on the selection of land for stone removal.

Soil Survey Oper., SCS, USDA, Washington, D.C.

Mapping and Interpretation

Agricultural Institute Review A LOOK AT CANADIAN SOILS. Agr. Inst. Rev. 15(2): 9-60. 1960.

The following papers are presented in this issue of the Agricultural Institute Review.

1. Ellis, J. H. THE CALL OF THE LAND. Winnipeg, Manitoba, Canada.
2. Moss, H. C. MAPPING OUR SOILS--THE WORK OF CANADIAN SOIL SURVEYS. U. Saskatchewan, Saskatoon, Saskatchewan, Canada.
3. Chapman, L. J. PHYSIOGRAPHY, CLIMATE AND NATURAL VEGETATION OF CANADA. Toronto, Ontario, Canada.
4. Stobbe, P. C. THE GREAT SOIL GROUPS OF CANADA--THEIR CHARACTERISTICS AND DISTRIBUTION. Canada Dept. Agr., Ottawa, Ontario, Canada.
5. Bowser, W. E. THE SOILS OF THE PRAIRIES. Alberta Soil Survey, Edmonton, Alberta, Canada.

6. Ehrlich, W. A., and Odynsky, W. SOILS DEVELOPED UNDER FOREST IN THE GREAT PLAINS REGION. Canada Dept. Agr., Winnipeg, Manitoba, Canada.
7. Farstad, L., and Rowles, C. A. SOILS OF THE CORDILLERAN REGION. Canada Dept. Agr. Res. Sta., Vancouver, British Columbia, Canada.
8. Matthews, B. C., and Baril, R. W. SOILS OF THE GREAT LAKES-ST. LAWRENCE LOWLANDS. Ontario Agr. Col., Guelph, Ontario, Canada.
9. Hills, G. A. SOILS OF THE CANADIAN SHIELD. Ontario Dept. Lands and Forests, Maple, Ontario, Canada.
10. Cann, D. B., and Millette, J. F. G. SOILS OF THE APPALACHIAN REGION. Canada Dept. Agr., Truro, Nova Scotia, Canada.
11. Nowosad, F. S., and Leahey, A. SOILS OF THE ARCTIC AND SUB-ARCTIC REGIONS. Canada Dept. Agr., Truro, Nova Scotia, Canada.
12. Hutcheon, W. L. THE APPLICATION OF INFORMATION FROM SOIL SURVEYS. U. Saskatchewan, Saskatoon, Saskatchewan, Canada.
13. Ripley, P. O., and Atkinson, H. J. ORGANIZATION AND MAJOR LINES OF SOIL RESEARCH. Canada. Dept. Agr., Ottawa, Ontario, Canada.
14. Dion, H. G. LAND USE IN CANADA--PRESENT AND FUTURE. Macdonald Col., Quebec, Canada.

Henry, E. F. ENGINEERING USE OF SOIL SURVEYS. Agr. Engin. 41: 305-309. 1959.

The Federal Housing Administration has used National Soil Survey reports and maps for a number of years. The use of these reports is now being expanded and supplemented by the development and expansion of the Unified Soil Classification System. Engineering interpretation of the various horizons or layers, as mapped by the National Soil Survey, is being made through the Unified Classification System. It is believed that the use of the unified system as a code or key will enable engineers to utilize valuable soil data that have heretofore been obscured. A method utilizing national soil surveys by interpretation and correlation with a popular engineering classification is presented.

Fed. Housing Adm., Washington, D. C.

Matelski, R. P. GREAT SOIL GROUPS OF NEBRASKA. Soil Sci. 88: 228-239. 1959.

The land area of Nebraska is about 50 million acres. Many soil scientists, agronomists, geologists, ecologists, and others have contribued significant findings concerning the genesis and classification of the soils of this area. The present report bases the description and distribution of the great soil groups in the area on these sources and the author's 10 years of study of soil formation factors.

Bibliography and Maps

U. Nebr., Lincoln, Nebr.

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Growth Through Agricultural Progress